Country case study – Poland

Climate for Sustainable Growth

Andrei Marcu, Project Leader
Tomasz Chruszczow
David Belis
Katja Tuokko
Wijnand Stoefs*

November 2015

This paper was prepared for the CEPS Project called Climate for Sustainable Growth.

The views expressed are attributable only to the authors in a personal capacity and not to any institution with which they are associated, or the funders and supporters of this project.

* The authors of this case study would like to gratefully acknowledge the cooperation of Aaron Cosbey who worked closely with the project team.

This case study is part of the CEPS project 'Climate for Sustainable Growth', whose main objective is to analyse the impacts of climate change mitigation measures on the three pillars of sustainable development: the economic, environmental and social dimensions.

It does so by looking at the positive as well as negative, both intended and unintended, impacts of climate change mitigation policies and projects. While this case study fully recognizes that policies have both positive and negative impacts, the focus of is on (potential) negative impacts of climate change mitigation policies.

The structure of this case study comprises of four sections:

(1) Country characteristics,
(2) Climate-related policies,
(3) Environmental, social and economic impacts of climate mitigation policies,
(4) Measures to mitigate impacts of mitigation policies,

This case study, and the methodology it follows, are not intended to analyse the merit of the policies and measures that are being implemented, or their effectiveness and efficiency, but will focus on their socio-economic-environmental impacts, and measures to alleviate these impacts in the period of transition.

It is important to note that lack of information and analysis of impacts and tools to mitigate negative impacts can act as a brake on ambitious climate action. This case study and the overall project's focus should be seen in this light.

CEPS
Centre for European Policy Studies
Brussels

Place du Congrès 1, B-1000 Brussels
Tel: 32 (0) 2 229.39.11 Fax: 32 (0) 2 219.41.51
e-mail: info@ceps.eu
website: www.ceps.eu

Executive Summary

This study is part of the project entitled “Climate for Sustainable Growth“ and focuses on whether climate mitigation policies and projects, implemented for the transition of Poland to a low GHG economy, are put in place in a sustainable way, by identifying their impacts on the three dimensions of sustainable development 1) economic 2) social and 3) environmental dimension. This is critical for the efficiency of implementation with which mitigation measures can be implemented, for the buy-in they receive from stakeholders and for ensuring that they meet the conditions for sustainable development, which implies there is progress on all three dimensions in a harmonious way.

This study looks at the positive and negative impacts of climate change mitigation polices and projects, and takes into account both domestic and international policies. After identifying the impacts, this study focuses on the domestic and international measures that are put in place to mitigate the (potential) negative impacts, both domestic, as well as international.

Given the broadness of the topic, this study sets boundaries through the selection of a limited number of sectors and policies on which the project will focus. The study looks at the following two sectors:

- Electricity generation sector
- Iron and steel sector

This study identified several international, European level and domestic climate change policies that impact Poland. For practical reasons, and to keep the empirical evidence to a manageable size, the impacts of two climate change policies, a) the EU emissions trading system (EU ETS) and b) domestic renewable support (RES) policies were chosen from an extensive list.

The positive and negative impacts of these two climate change policies are analysed in various areas (costs, employment, trade, investments, production & capacity, prices, environment), to ensure that all three dimensions of sustainable development are covered.

This study finds that climate change mitigation policies result in both positive and negative impacts on the three dimensions of sustainable development. However, the study shows that some potential impacts did not materialise due to mitigation measures that were put in place.

Firstly, for the electricity sector, this study finds that climate change policies have had both positive as well as negative impacts. The direct costs of the EU ETS have not produced a major impact in the electricity sector. On the other hand, thanks to high levels of free allocation and a very high pass-through rate, the EU ETS has likely resulted in substantial windfall profits for the sector, at least in the period 2008-2012. Since free allocation mechanisms of EU ETS are changing post-2020, in the future the direct costs will increase, while windfall profits are likely to slowly disappear.

As the costs of EU ETS have been passed through, it is very likely that this climate change policy has had an impact on electricity prices increasing the cost of electricity for households and industry. This impact is both economic and social since it is likely to cause an increase in electricity bills for Polish consumers.

This study finds that GHG emissions from Polish electricity sector have decreased from 2008 to 2014. Although this trend could have been the result of many causes (including lower energy generation due to the financial crisis combined with others e.g. clean air policy), the EU ETS has quite likely played some role in GHG emission reductions in the Polish electricity sector, therefore generating a positive environmental impact. To quantify the cause-effect equation is a complex task that would require a substantial number of assumptions.

RES in Poland have also had both positive and negative impacts. The positive economic impacts are the incentives for investment in renewable energy driving job creation and increase in renewable energy production. While difficult to quantify due to lack of data, this has created employment, which has generated a positive economic and social impact.

On the other hand, the green certificates scheme has had economic impacts. It has, as planned, initiated changing of the technology and fuel mix in electricity generation away from coal and lignite towards renewable energy, namely to biomass and (to some extent) wind power. The additional cost is passed on to electricity consumers.

Therefore, like the EU ETS, the RES support policies have had a social impact by generating higher electricity prices for consumers. On the other hand, RES policies have likely played some role not only in GHG emission reduction in the Polish electricity sector, but also in reducing other types of emissions from power plants, such as Sulphur dioxide nitrous oxides and particulate matters (dust).

When it comes to electricity generation from hard coal and lignite, RES policies can have some negative economic and social impact, due to limiting the demand of electricity generated from these sources, and directly related employment, at those facilities. However, since a large part of biomass in Poland is biomass combustible, this impact could be compensated to some extent by the employment gains in that sector and should not be overstated.

Secondly, climate change policies have had both positive and negative impacts on the Polish steel and iron sector. The direct and indirect costs of EU ETS to the steel and iron sector have been low overall, but not insignificant in all cases.

Therefore, in the short-term, it is safe to say that the sector has not experienced major negative economic impacts due to EU ETS. Due to strong measures to avoid carbon leakage, the sector has actually benefited from windfall profits, certainly during the 2008-2012 period. Since the EU ETS is being strengthened at the EU level, in the long term, it is likely that we will see increasing negative economic impacts.

At the same time, EU ETS has resulted in some environmental gains, as it has been responsible for some of the GHG emissions reductions that the iron and steel sector has seen in the period 2008 – 2014.

This study finds that flanking measures (measures to mitigate social, economic and environmental impacts) were put in place in Poland, which significantly decreased the level of the impacts observed in the two sectors selected for this case study.

The EU level flanking measure used is free allocation of EUAs granted to installations in both the electricity and iron and steel sectors, which significantly mitigated the potential negative economic impacts of EU ETS for both sectors. Even though free allocations shielded the two sectors from the impacts of EU ETS, it did not prevent the impacts totally, and could not shield consumers of electricity faced with price increases.

Also, international flanking measures, such as World Bank support, and Joint Implementation projects, were also identified, and provided funds. As industrial players in the EU ETS were allowed access to international credits, which are generally cheaper than EUAs, this is also an important cost mitigation measure.

In addition, further EU-level and international tools were identified (NER 300 for renewable energy and CCS projects, the Proposed EU ETS Modernization Fund (post-2020), EU-level R&D funding (such as Horizon 2020 funding)) which Poland can use to mitigate the impacts of climate change policies.

Domestic mitigation tools, such as Green Investment Scheme, the legislation on Thermo-modernization Programme and Fund, as well as support for micro-installations under the 2015 Renewable Energy Act, all serve to mitigate the impacts of rising electricity prices for households.

The various programmes under which subsidies are granted to the coal industry have alleviated many of the social (employment) concerns within the coal sector in Poland, and demonstrated the importance of social dialogue and the availability of a domestic and EU safety net.

In summary, many negative impacts were mitigated, while recognising that at this time policies are young and EUA prices are low, and therefore impacts remained small. However, both climate change policies discussed in this study are going through changes as the result of the various pieces of legislation being currently examined in the EU. This might mean that in the future these policies can generate bigger impacts for the electricity and iron & steel sectors.

One of the lessons learned from this case study is that there are flanking measures in place in Poland to address the negative impacts of the transition that has taken place during the last decades towards a market economy. This gives an indication of the importance of having a safety net in place to address possible negative impacts resulting from climate change policies, as well as the fact that there is little attention given to potential impacts outside Poland, and whether other jurisdictions, or internationally, such safety nets exist.

It must be emphasized that this discussion must not be in any way be interpreted or construed as encouraging lack of mitigation action. On the contrary, it must be seen as providing a way forward that will ensure that action can be undertaken with full support by all stakeholders, domestic and international.

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1 Country characteristics

1.1 Drivers of transition to a low GHG economy

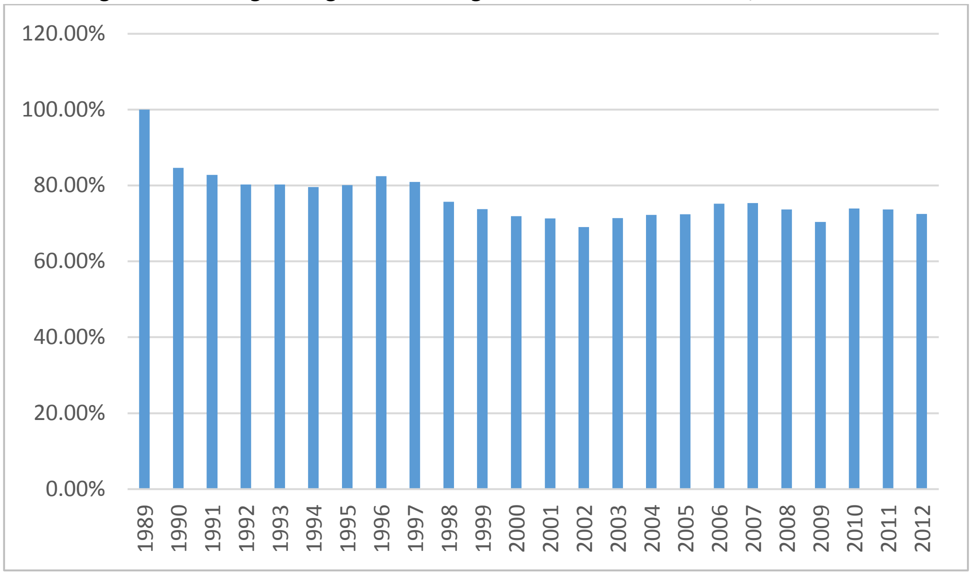
Up until the late 1980s, Poland was part of the Soviet bloc, with a centrally planned economy based mostly on heavy industry. A rapid political, economic and social transformation started in 1989, after the first (partly) democratic elections. This opening chapter looks at the most significant factors that have driven the transition towards a low-GHG economy in Poland.

Firstly, the need to modernise the economy and the development of innovation potential in the market for green technologies has been the most important internal driver of transition to a low-GHG economy. Since 1989, the 'deep' reconstruction of the economy resulted in an increase of energy efficiency due to organisational, technical and technological changes in the manufacturing processes. This, in turn resulted in a reduction of carbon as well as other GHG emissions (Figure 1). This abrupt decrease of GHG emissions is one the most remarkable results of Poland's economic modernisation in the last 25 years. In 1989, according to the UNFCCC, total GHG emissions excluding LULUCF amounted to 551 million tonnes of CO_2-eq, while in 2012, they stood at 399 million tonnes, representing a reduction of 27.5% between 1989 and 2012.

Compared to the rest of Europe, however, the energy intensity of the Polish economy remains high. Poland ranks seventh from the bottom among EU member states. According to Eurostat data, in 2010, the energy intensity of the Polish economy was 373.9 kgoe/€1,000 compared to 168 kgoe/€1,000 for the EU-27.

* *Andrei Marcu is Head of Carbon Market Forum at CEPS. Tomasz Chruszczow (Polish Foundation for Climate Change), Wijnand Stoefs is Research Assistant at CEPS Carbon Market Forum, David Belis is Research Assistant at CEPS Carbon Market Forum and Katja Tuokko is Research Assistant at CEPS Carbon Market Forum.*

Figure 1. Changes in greenhouse gas emissions in Poland, 1989-2012



Data source: UNFCCC.

Secondly, after a decade of reforms, Poland became a member state of the European Union in 2004. As a member of the EU, Poland is required to transpose European legislation into national laws. This membership in the EU is the single-most important external factor driving the transition to a low-GHG emissions economy.

Poland certainly has a strong voice in the policy-making process at the EU level and has influenced the outcomes at various points in time. Poland believes that the adoption of a single approach and single timeline for every EU member state, irrespectively of their energy mix, structure of power system as well as ability to cover the costs, is not the way forward. Poland did not agree, for instance, with the 2050 Roadmap to a low-carbon economy, proposed in 2011. There are also issues with the timely implementation and transposition of European rules at the domestic level (Skjaerseth, 2014). Generally speaking, the dynamics at the European level are nevertheless driving much of the transition at the national level, particularly during the last 10-15 years.

Other external drivers include building a geopolitical position and international reputation for the state in international forums, changing patterns of consumption and related export opportunities for green technologies.

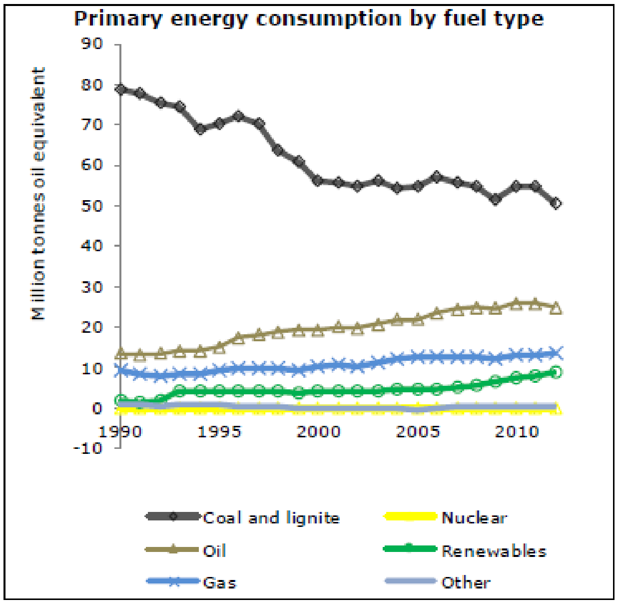
In addition, some of the local governments are more open to the development of 'decentralised' renewable energy systems (as opposed to the large energy firms) that support the development of biomass co-firing in their coal-fired power plants. The development of democratic pluralism is relevant here, particularly in terms of stakeholder involvement in climate governance, as public concerns are more likely to be taken into account than previously. Environmental groups drive the transition by means of attempting to generate social and political pressure, and aim to tackle the generally rather low level of climate awareness in Poland.

A final driver is related to Poland's vulnerability to the adverse effects of climate change on the domestic economy. Particular attention is paid to the real threats posed by climate change disasters reinforced by phenomena like floods, droughts, forest fires and extreme weather events.

1.2 Energy consumption, electricity generation and key sectors of the Polish economy

In view of its large domestic coal deposits, it is not surprising that over 50% of Poland's energy is sourced from *hard coal and lignite* (see Figure 2). In recent years, however, hard-coal extraction has fallen, due to variety of reasons such as old mines becoming unprofitable and energy-saving technologies decreasing demand of coal.

Figure 2. Primary energy consumption by fuel type in Poland, 1990-1010

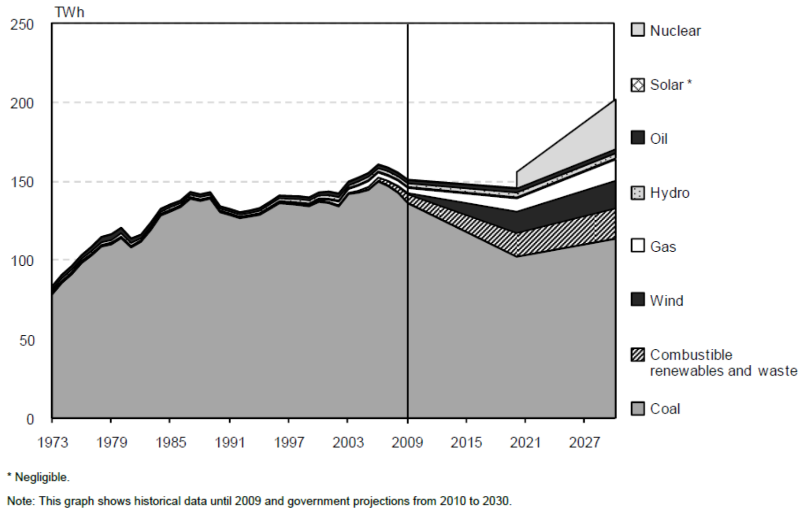


Source: EEA (2014).

In terms of the electricity mix, Poland relies on domestic coal and lignite for about 84% of total generation (for the year 2014, based on data obtained from the Energy Regulatory Office).[1] The remaining 16% is split mainly between natural gas and biomass (co-firing), in addition to hydropower (little growth potential) and wind (whose share is growing). There are plans to promote and diversify power generation, including by developing nuclear power and increasing the shares of combustible renewables, wind power and natural gas (Figure 3). Due to high (and rising) costs, the future of nuclear in Poland is not yet guaranteed (stakeholder interviews).

[1] This figure excludes electricity generated and used directly by industrial plants.

Figure 3. Electricity generation in Poland, 1973-2030



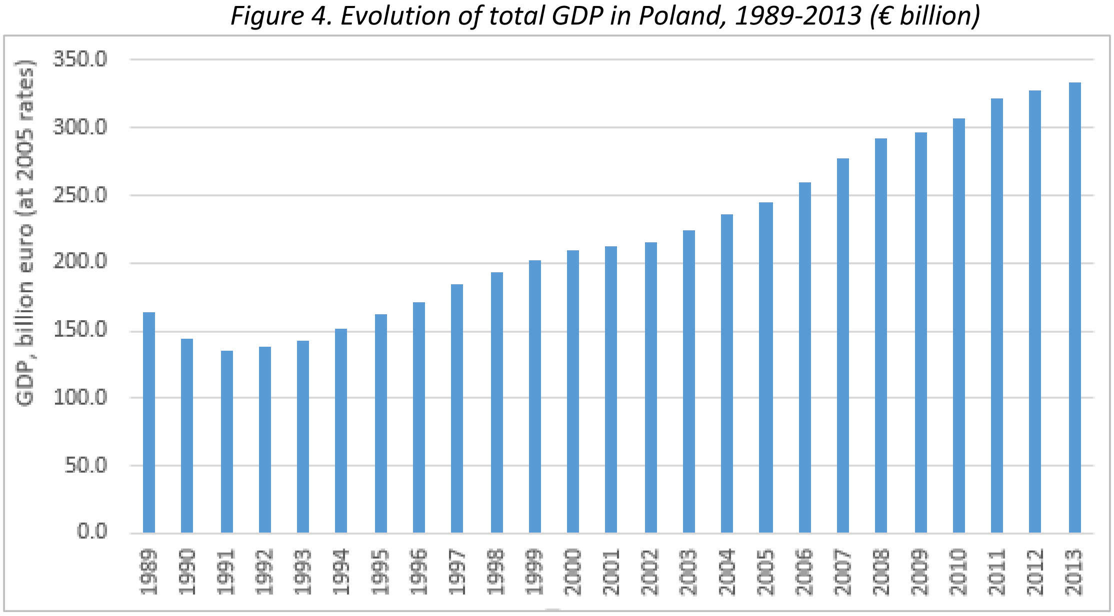
Source: IEA (2011, p. 63).

Following a decrease in total GDP in 1989 and 1990, the Polish economy started to grow again from the early 1990s and nearly tripled in size by 2013 (see Figure 4), at an average annual growth rate of around 4%.

The broader economic transition resulted in a decoupling of emissions and economic growth, with emissions just above 70% of 1989 levels in 2012, while the size of the economy nearly tripled (see Figures 1 and 4).

Currently, industry remains the dominant sector generating economic growth in Poland. The highest growth rate can be found in the manufacturing industry (including e.g. chemicals, machinery, iron & steel, cars and textiles), which determines the growth rate of industry as a whole.

Figure 4. Evolution of total GDP in Poland, 1989-2013 (€ billion)



Data sources: EUROSTAT 2015 and UN STAT 2015.

Table 1 shows the main sectors of the Polish economy (as shares of gross value added per year). Between 1995 and 2011, agriculture decreased in importance (nearly 4%), while services increased as a share of total gross value added (about 5%). In industry, the manufacture of basic metals and metal products, including iron & steel, and the manufacture of rubber, plastics and other non-metallic products, including cement, stand out as major sectors (< 2%). Mining and quarrying decreased about 1% as a share of global value added during this period.

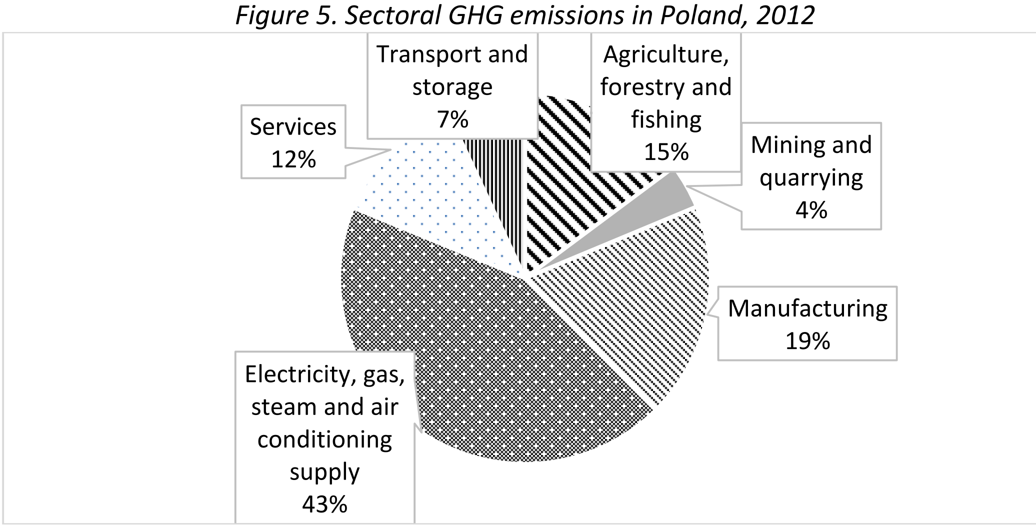
Table 1. Shares of gross added value, per sector, per NACE code, 1995-2011

	1995	2000	2005	2010	2011
Agriculture, forestry and fishing	7.92%	4.95%	4.59%	3.74%	4.03%
Mining and quarrying	3.69%	2.41%	2.54%	2.45%	2.74%
Manufacture of coke and refined petroleum products	0.06%	0.57%	0.75%	0.70%	0.87%
Manufacture of wood, paper, printing and reproduction	2.04%	1.76%	1.59%	1.48%	1.51%
Manufacture of basic metals and metal products (incl. iron & steel)	2.44%	1.95%	2.14%	2.08%	2.47%
Manufacture of rubber, plastics and other non-metallic mineral products (incl. cement)	2.13%	2.37%	2.35%	2.31%	2.34%
Manufacture of chemicals and chemical products	1.30%	0.99%	0.97%	0.83%	0.94%
Other manufactured goods	11.76%	9.58%	9.95%	9.40%	9.27%
Construction	7.67%	7.82%	6.29%	8.10%	8.23%
Electricity, gas, steam and air conditioning supply	3.21%	2.59%	3.11%	3.53%	3.38%
Transportation and storage	4.67%	5.14%	5.52%	5.51%	5.68%
Services	56.49%	63.85%	63.75%	62.91%	61.58%
Total Gross Value Added	100.00%	100.00%	100.00%	100.00%	100.00%

Data source: EUROSTAT 2015.

Sectoral GHG emissions for the year 2012 show that electricity, gas and steam account for 43% of total national emissions, followed by manufacturing industries at 19%. Agriculture, forestry and fishing are also quite important (15%), followed by services (12%) and transport (7%). Mining and quarrying, finally, account for about 4% total domestic emissions (see Figure 5).

Figure 5. Sectoral GHG emissions in Poland, 2012



Data source: EUROSTAT 2015.

1.3 Sector selection

In addressing climate change all sectors of the economy need to contribute. However, from a methodological point of view, this study will set boundaries through the selection of a limited number of sectors.

The sectors are selected based on two criteria: 1) the contribution of the sector to Poland's GHG emissions and 2) the importance of the sector for the Polish economy. The application of these two criteria results in the selection of two sectors:

- Electricity generation
- Iron and steel

Electricity generation is very important in the economy, as it fuels growth in a variety of sectors (including services and industry) and sustains society's electricity needs (e.g. households and public lighting). Electricity accounted for 43% of total domestic emissions in 2012 (EUROSTAT, 2015; Figure 5) and accounted for over 3% of total value added (EUROSTAT, 2015; Table 1).

The *iron & steel* sector is also an important part of Poland's energy-intensive manufacturing industry. Manufacturing as a whole accounted for 19% of total domestic emissions in 2012, second only to electricity (EUROSTAT, 2015; see Figure 5). The manufacture of basic metals and metal products (including iron & steel) accounted for 2.47 % of total value added in 2011 (EUROSTAT, 2015; Table 1).

Both sectors have evolved considerably since the start of reforms and modernisation in 1989, and are continuing to adapt to these new circumstances. It is against this larger background that initiatives aimed at putting these sectors on a low GHG pathway need to be analysed.

1.4 Concerns related to implementation of climate policies in Poland

There exist a number of serious concerns in Poland that may hinder the transformation towards a low-GHG economy. These concerns can be identified as economic, social and political in nature and are elaborated below.

1.4.1 Economic concerns

An overarching concern is international competitiveness and potential carbon leakage, which essentially means relocation of production or investments to third countries. Implementation of climate policies can lead to carbon leakage, which would mean GHG emissions being displaced to a country where less constraining climate change policies are in place.

Another major economic concern is energy security. The IEA (2011, p. 24) states: "a driving force for Poland's energy policy is high dependence on Russia for energy imports. In 2007, Poland imported 97% of its needs in oil and 68% of its needs in gas". Poland aims to reduce its dependency on Russia and therefore needs to diversify its energy sources and supply routes for example by building an entry point for liquefied natural gas to be delivered from the Gulf area. However diversification has so far proven difficult and Poland remains therefore committed to (domestic) coal.

1.4.2 Social concerns

As the implementation of ambitious climate policies may severely affect the manufacturing and energy industries, not to mention the coal-mining industry, there are widespread fears that these policies may lead to significant job losses in these sectors. The general public is also concerned about potential impacts on the standard of living, increased costs (especially energy/electricity) and decreased household disposable incomes.

1.4.3 Political concerns

The socio-economic concerns translate into criticism of EU climate policy as a barrier to development for less prosperous member states. There is widespread agreement across the entire political spectrum in Poland (including the two biggest parties, Civic Platform and Law and Justice) not to be overly ambitious in terms of climate policies (Skjaerseth, 2014). Significant industrial stakeholders that see ambitious climate action as an existential problem have an important voice and this reinforces the above-mentioned concerns at a political level.

1.5 Conclusion on the socio-economic and environmental evolutions in Poland

Poland's transition to a market economy since 1989 has had as a co-benefit a sharp reduction of GHG emissions; however, there is nothing that guarantees a further and more sustainable transition towards a low-GHG economy. A critical element in the make-up of Poland's emissions is the dominance of the power sector and its extraordinary dependence on coal. About 84% of grid electricity in Poland is generated from coal and lignite, the highest share in the EU, which makes Poland an outlier both in Europe and globally.

The Polish economy, despite advances in several manufacturing industries, remains very energy intensive, mainly due to transportation and infrastructure (e.g. old age of the average coal-fired power plant, discussed below). Poland ranks seventh from the bottom among EU member states in terms of energy intensity. But the country is on its way to reach both its GHG and renewable energy targets within the context of the EU's 2020 targets, and has accepted the EU's proposed 40% target by 2030.

This shows that, despite serious socio-economic and political concerns in the country, a transition towards a low-GHG economy has been initiated. Largely driven by EU climate and energy policies, key sectors of the Polish economy will increasingly have to contribute to this transition. Measures to mitigate the potential negative socio-economic impacts of those policies are necessary and will need to be carefully crafted to fit the needs of both the environment, the economy and society at large.

2 Climate change mitigation policies

As mentioned above, the project methodology sets boundaries as a recognition of the limited scope of this case study. The first boundary was set through the selection of the two sectors that constitute the focus of the case study: electricity generation and iron & steel.

The second boundary relates to the selection of policies that impact each sector. For practical reasons and to keep the empirical evidence to a manageable size, this case study focuses on

European and Polish climate policies that have had the most significant impact on each of the two selected sectors (electricity generation and iron & steel).

This case study identifies the EU emissions trading system and renewable support policies (notably the domestic green certificate scheme that helps Poland to achieve its RE target set by the EU) as the climate change policies that have had the largest impacts on the two sectors. Some of the other policies, including e.g. the Industrial Emissions Directive (IED) or the Mercury Convention also potentially have some (future) impacts on the selected sectors, but due to the limited scope of this case study, we leave them out of the analysis.

The sections below present the most important policies on the international, European and national level. We list those policies that are agreed upon at international level and impact a wide range of jurisdictions, as internationalpolicies. We then list European policies separately from national and international policies as Poland, as part of the EU, has to follow EU legislation and transpose the necessary laws into its own national legislation.

Only those policies and programmes that have the most significant impact on each of the two selected sectors (electricity generation and iron & steel) are described here in detail. Other climate change policies that are listed here, are described in Annex I.

2.1 International policies

1. The *United Nations Framework Convention on Climate Change (UNFCCC)*, is the umbrella agreement of the global climate regime with near-universal membership aiming at stabilisation of greenhouse gas concentrations in the atmosphere.
2. *Kyoto Protocol* established binding targets for Annex I Parties to the Convention (developed countries), while Non-Annex I Parties (developing countries) did not have to take on any reduction obligations. Collective emissions reductions for the EU amounted to 8% below 1990 levels in the first commitment period (2008-2012).
3. The *Montreal Protocol on Substances that Deplete the Ozone Layer* aims to reduce consumption of ozone-depleting substances so as to protect the ozone layer. Poland ratified the Montreal Protocol in 1990.
4. The *1979 Geneva Convention on Long-range Transboundary Air Pollution (LRTAP)* tackles air pollution (SO_2 and other pollutants) on a transnational (regional) basis.
5. The *International Civil Aviation Organization (ICAO)* agreed to establish a global market-based mechanism (MBM) so as to address the GHG emissions of the international aviation sector. The mechanism should be developed by 2016 and it should enter into force by 2020.
6. In the *International Maritime Organization (IMO),* a global market-based measure (MBM) to mitigate GHG emissions is under discussion. MBMs under consideration include an offsetting fund financed by a tax on bunker fuels, an energy-efficiency crediting and trading scheme and a global ETS for international shipping.
7. The *Minamata Convention on Mercury* agreement is indirectly related to climate change, as coal, burned around the world to generate electricity, also emits mercury. (UNEP, 2013, p. ii). Poland has signed but not yet ratified the Convention.

2.2 EU policies

1. The *EU emissions trading system (EU ETS),* Europe's flagship climate policy, was adopted under Directive 2003/87/EC and covers more than 11,000 energy-intensive installations or more than 45% of total GHG emissions in the EU. The EU ETS is a cap-and-trade system first implemented in 2005, with the goal of providing a cost-effective tool to reach the greenhouse gas (GHG) targets that the EU has committed to. The European Union has set an EU-wide target to cut emissions from sectors covered by the EU ETS by 21% by 2020 compared to 2005 levels.

   In its Article 10a, the ETS Directive addresses the concern of carbon leakage. Those sectors or sub-sectors that are at risk of carbon leakage receive a higher share of free allowances since they face competition from industries in third countries that are not subject to similar restrictions on GHG emissions. One of the sectors this case study concentrates on, the iron & steel sector, has been placed on the list of sectors and subsectors that are deemed to be exposed to a significant deemed risk of carbon leakage (European Commission, 2009d).

2. The *Renewable Energy Directive* establishes a policy for the production and promotion of energy from renewable sources in the EU. The EU-wide objective is to fulfil at least 20% of total EU energy needs with renewables by 2020. This target is split into individual national targets, ranging from 10% (Malta) to 49% (Sweden). Poland has a target of 15%. Each EU member state also has the obligation to reach a 10% share of renewables in transport (through biofuels).

3. The *Industrial Emissions Directive (IED)* deals with pollution from various industrial sources such as , "emissions to air, water and land, generation of waste, use of raw materials," (European Commission, 2015d). Operators of more than 50,000 industrial installations are required to hold an integrated permit issued by national authorities. The IED is based on five principles, namely 1) an integrated approach, 2) best available techniques (BAT), 3) flexibility, 4) inspections and 5) public participation.

In addition, other climate change-related EU policies include the following (see Annex I):

4. Effort Sharing Decision (ESD)
5. CCS Directive
6. Energy Efficiency Directive
7. Energy Performance of Buildings Directive
8. Fuel Quality Directive
9. Car Standard Regulations
10. F-gas Regulation

2.3 National policies

In general, climate policies fall under the larger umbrella of Polish development policy, which includes a *National Development Strategy 2020*, long- and medium-term development strategies and nine more specific Integrated Strategies on topics such as regional development, energy security and environment, whose aim is to assist in achieving the development objectives. Low-carbon development and green growth are also mentioned in the *Medium-Term*

National Development Strategy to 2020, and the *Long-Term National Development Strategy 2030*, two of Poland's most important strategic national development documents.

The following national policies and programmes are the most significant for this case study.

1. The 2010 *National Renewable Energy Action Plan* was adopted pursuant to the EU's 2009 RES Directive and, with reference to the *Energy Policy of Poland*, sets out a path for Poland to achieve its 2020 RE target, i.e. to increase the share of renewable energy of its total annual energy consumption to 15%. The most important scheme is a quota system whereby entities must have a certain amount of certificates of origin in their portfolio. There are several varieties of certificates, but the most important ones are the green certificates, representing energy generated from renewables.

   In 2015, a new *Renewable Energy Act* was adopted, which transposes EU Directive 2009/28/EC on renewable energy into Polish legislation. Overall, the new act will reduce state support for renewables, from an estimated PLN 8.9 billion by 2020 based on the old system, down to PLN 4.26 billion under the new system during the same period (Schonherr, 2015). In contrast, the act foresees that the bulk of small-sized renewable power plants will benefit from feed-in tariffs, including at least 200,000 prosumers (those that both produce and consume energy; see chapter 4 for additional details).

In addition, the following climate change-related national programmes are significant for this case study.

2. The *Thermo-modernization Fund*, in place since 1998, constitutes the largest mechanism for energy efficiency financing in the building and construction sector (Rekiel, 2014).

3. Poland's *Green Investment Scheme (GIS)*, operated by the National Fund for Environmental Protection and Water Management, links the sale of Assigned Amount Units (AAUs) under the Kyoto Protocol's International Emissions Trading instrument, to the development of 'green' projects in Poland.

Other national policies, legislations and development programmes can be identified (see Annex I):

4. 2003 Poland Climate Policy
5. Polish Strategic Plan for Adaptation to Climate Change (SPA2020) with the perspective by 2030
6. National targets on EE, biofuels (included in the various EU directives)
7. Energy Policy of Poland until 2030
8. The Act of 15 April 2011 on Energy Efficiency
9. The Act of 25 August 2006 on Bio-components and Liquid Biofuels & The Long-term Program to Promote Biofuels or Other Renewable Fuels for 2008–2014
10. Operational Programme Infrastructure and Environment for the years 2007-2013 / 2014-2020

11. Transport Development Strategy for 2020 (with the prospect of 2030)

2.3.1 Are impacts of climate change policies monitored?

At the national level, every single piece of legislation (on all levels – international, EU, national) must in principle undergo an impact assessment procedure, which includes impacts on the state budget, the economy, social costs, including the labour market, and the environment. In case of international conventions to be adopted by Poland, the necessary changes in national legislation and its potential impacts are taken into consideration before taking the decision authorising Polish representatives to begin a negotiating process.

The assessment process (of new legislation or policy) includes wide consultations with interested parties, including individuals, civil society and business organisations. They may use online tools foreseen for that purpose. Every strategic document, including policies, need to undergo a strategic Environmental Impact Assessment.

Even though the National Database by KOBiZE collects data on GHG emissions (KOBiZE, 2015), a direct and comprehensive monitoring of the impacts resulting from the implementation of policies and measures to reduce greenhouse gas emissions is not carried out in Poland. The data collected are mostly used to identify the emissions for certain activities and processes, inter alia, for the purposes of reporting to the United Nations Framework Convention on Climate Change, the EU's greenhouse gas monitoring mechanism, the ETS scheme and other schemes.

Monitoring however does cover those measures that have been financed with public resources or EU funds. Monitoring of air pollution, for example, as well as the reporting system covering emissions other than of GHGs help to understand the impacts of implemented policies and measures. Additionally, all projects (both public and private) supported by the National Fund have to report on the environmental benefits, including emissions reductions, energy savings, etc. These data presented against the cost are a good illustration of investment efficiency.

2.4 Conclusion on climate change policies

This case study identified the EU emissions trading system and renewable support policies as those climate change policies that are of crucial relevance for the electricity and iron & steel sectors in Poland. The impact analysis in the next chapter will be limited to this smaller selection of policies.

The next chapter will analyse the socio-economic and environmental evolutions within both the electricity generation and iron & steel sectors, and identify the (potential) negative and positive impacts that are attributable to the EU ETS and RES policies in Poland.

3 Impacts of climate change mitigation policies

This chapter analyses the positive and negative, economic, social and environmental impacts of climate change policies in Poland's electricity generation and iron & steel sectors. We observed positive and negative impacts, which can be intended or unintended.

As mentioned previously, this case study sets its scope by defining two boundaries, i.e. through the selection of relevant sectors (the electricity sector and the steel and iron sector) and the selection of key climate policies that have the greatest impact on those sectors (EU ETS and RES policies).

This chapter consists of two parts. In the first part, we examine the electricity sector, and in the second part we look at the iron & steel sector.

In each part, we describe the sector and then analyse the impacts of the key climate policies on the following areas:

1. Economic impacts
    - costs (direct and indirect)
    - trade
    - investments
    - production and capacity
    - prices
2. Social impacts
    - employment
    - affordability of energy for households
3. Environmental impacts
    - GHG emissions

3.1 Impacts in the electricity generation sector

3.1.1 Sector description

Some 84% of Poland's electricity sector is based on coal (hard coal and lignite). Lignite accounts for around 35% of yearly electricity generation in Poland. It is important to note here that lignite is more GHG-intensive than hard coal. The CO_2-intensity of hard coal is 94.6 tonne CO_2 per terajoule (TJ), while lignite emits on average 101.2 tonne CO_2/TJ (Ecofys, 2014, p. 14).

Another specificity is a heavy reliance on combined heat and power (CHP) plants. Poland is one of the few countries in the world relying to such an extent on the combined production of electricity and heat. About a third of all thermal power plants in Poland are CHP plants (IEA, 2011: 62).

The sector faces a number of important challenges in the years ahead, one of which is the scale of investments required to replace Poland's rapidly aging generation capacity, with nearly half of today's installations older than 30 years. Electricity networks are also ageing and require similar investments (IEA, 2011, p. 11).

Poland has announced that it will continue to rely on coal as its most important source of electricity generation, but its relative share will gradually decline (see Energy Policy of Poland, 2009), while the options to upscale other sources of electricity, such as wind power, biomass and nuclear are actively being explored. There are various reasons for these developments, including the fact that economically recoverable hard coal and lignite reserves in established mines in Poland are declining very fast. Production is likely to decrease considerably by 2030, and, since the late 2000s, Poland is already increasingly relying on imported hard coal in addition to domestic production (see below; see also IEA, 2011, p. 11).

Still, all official projections show the continuation of a very large proportion of coal-based electricity generation in the Polish energy mix, despite related GHG emissions and climate change concerns.

In the early 1990s, a process of commercialisation, decentralisation and privatisation resulted in the unbundling of the sector into three sub-sectors, i.e. generation, transmission and distribution. Power plants started to operate as individual companies, selling all their production via Power Purchase Agreements to the Polish Power Grid Company, which then resold the electricity to a number of distribution companies. In the 2000s, the government decided to gradually consolidate the sector, leading to the establishment of four major players, – PGE, Tauron, ENERGA and ENEA – which together control the bulk of the Polish electricity market (for more details, see Kaminsky, 2012, pp. 138-139).

In this case study, we focus the analysis on the 74 installations that we identified in the EU ETS registry as being electricity providers to the Polish grid. These plants include public CHP plants[2] and public power plants, but exclude power installations that generate electricity immediately at industrial plants.

3.1.2 Economic impacts

Cost impacts of climate policies

This section looks at the cost impact of two different climate policies: a) EU ETS and b) RES policies. In the electricity sector, we look at the direct costs that these policies generate.[3] While some of these cost impacts are intended consequences of EU ETS and RES policies, they have impacts which are unintended.

A) EU Emissions Trading System – Direct costs

As mentioned in chapter 2, the EU ETS is a cap-and-trade system first implemented in 2005, with the goal of providing a cost-effective tool to reach the greenhouse gas (GHG) targets to which the EU has committed itself. EU ETS compliance is set at the installation level. Each year, each installation must surrender a number of emission permits equal to its emissions during the past

[2] No data are available to differentiate between emissions that result in electricity generation and heat generation inside combined heat and power plants. For this reason, we have included all CHP installations in their entirety in the scope of this study.

[3] As discussed below, these direct costs translate into indirect costs for other sectors. Possible administrative costs are not discussed in this study.

year. The compliance units are European Union Allowances (EUA), which represent one tonne of CO_2-equivalent emissions. The total cap is equal to the total sum of EUAs made available each year through free allocation or auctioning. Underneath that cap, market participants, including covered installations, are free to trade.

The EU ETS is now in its third phase (2013-20). Given their different characteristics, the three phases have different cost impacts for the participating installations. We will focus on Phases 2 (2008-12) and 3 (2013-20), and exclude the pilot phase (Phase I, 2005-07) as an acknowledgement of the limited scope of this study.

In phase 2 (2008-12), free allocations were granted on the basis of the reported emissions in the pilot phase. However, the 2008-09 economic crisis had a clear impact and substantially decreased emissions in Phase 2. This contributed to the build-up of a surplus of allowances, estimated by the European Commission to be around 1.5 to 2 billion EUAs at the end of phase 2 (European Commission, 2012a; for a more detailed explanation of the system of free allocation, see chapter 4 on the mitigation of impacts).

Phase 3 (2013-20) saw a number of significant changes. Since 2013, auctioning has increased, and more than 40% of all allowances will be auctioned. Central to this part of the study is the fact that the power sector has in principle moved to full auctioning. However, in certain countries (including Poland) transitional free allocation is granted to the sector. It is important to note that transitional allocation will decrease progressively towards 2020 (European Commission, 2012c).

This study analyses the cost impact of the EU ETS over the period 2008-14 (i.e. Phase 2 and the first two years of Phase 3). The following methodology is used to calculate the direct costs of the EU ETS in the electricity-generation sector in Poland:

$$Direct\ EU\ ETS\ cost\ \left(\frac{€}{MWh}\right) = \frac{[Emissions\ (Tonne\ of\ CO_2) - Allocations\ (Tonne\ of\ CO_2)] * CO_2\ price\left(\frac{€}{Tonne\ of\ CO_2}\right)}{Production\ (MWh)}$$

Where:

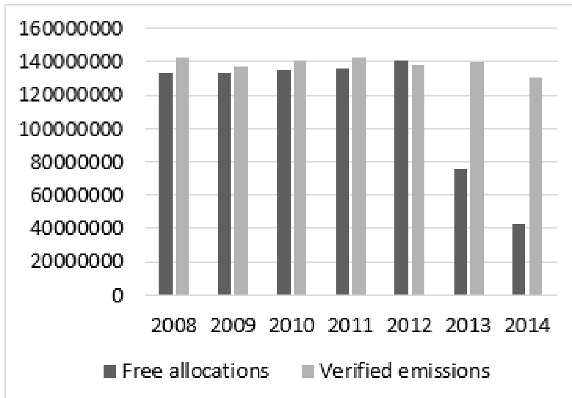
- <u>Emissions</u> are the verified emissions of the installation (EUTL, 2015 and KOBiZE, 2015)
- <u>Allocations</u> are the EUAs freely allocated to each installation (EUTL, 2015 and KOBiZE, 2015)
- <u>CO_2 price</u> is the average yearly market price of EUAs (European Energy Exchange, 2015).
- <u>Production</u> is the estimated production of electricity per MWh from public power plants and from public combined heat and power plants (KOBiZE, 2015).

Essentially, the cost of compliance per MWh of produced electricity is the difference between the amount of EUAs each installation needs to surrender and the number of allowances allocated, multiplied by the cost of the allowances purchased and divided by production.

- *EU ETS direct cost: Results*

First, Figure 6 demonstrates that the electricity sector has not been over-allocated throughout the 2008-14 period, except for the year 2012 (the dark bars show the amounts of free allocation).

Figure 6. Free allocations and verified emissions in the electricity sector, 2008-14 (hard coal and lignite)



Data sources: EUTL (2015) and KOBiZE (2015).

Second, as discussed above, we know that there is a difference in the carbon intensity of hard coal and lignite, it is interesting to differentiate between those two fuel sources in our analysis. Table 2 therefore shows the emissions, allocations and the difference between emissions and allocations for hard coal-fired plants and lignite-fired plants.

Table 2. Emissions and free allocation in electricity sector 2008-14, hard coal and lignite (in millions)

Year		**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Hard coal								
	Emissions	87.2	84.5	90.1	88.3	81.9	82.0	75.0
	Allocations	83.2	83.4	85.6	85.9	86.1	50.7	36.3
	Difference	**4.0**	**1.1**	**4.5**	**2.5**	**-4.2**	**3.1**	**3.9**
Lignite								
	Emissions	55.9	52.1	50.3	54.0	56.0	57.8	55.1
	Allocations	49.8	49.8	49.8	49.8	54.6	25.4	6.5
	Difference	**6.1**	**2.4**	**0.5**	**4.2**	**1.4**	**32.3**	**48.5**

Authors' elaboration on data from: EUTL (2015) and KOBiZE (2015).

This shows in more detail that the sector was not over-allocated (except hard coal-fired plants in 2012), and that the share of emissions short in allowances has increased significantly for lignite-fired plants as of phase 3 of the EU ETS (2013-14).

Third, the next step is to apply the formula described above, using the average EUA prices as listed in Table 3, and production figures we obtained from Kobize (2015).

Table 3. EUA prices in the EU ETS, 2008-14 (€)

Year	2008	2009	2010	2011	2012	2013	2014
EUA price	23.03	13.31	14.48	13.77	7.56	4.50	5.92

Authors' elaboration on data from: European Energy Exchange (2015).

This then results in the direct costs stemming from the EU ETS as a climate change policy mitigation to the Polish electricity sector.

Table 4. Direct costs for hard coal and lignite power plants (€/MWh)

Year	2008	2009	2010	2011	2012	2013	2014
Hard coal Direct costs	€1.08	€0.18	€0.73	€0.37	-€0.38	€1.66	€2.86
Lignite Direct costs	€2.64	€0.63	€0.17	€1.08	€0.18	€2.56	€5.31

Authors' elaboration on data from: EUTL (2015) and KOBiZE (2015).

Table 4 shows that direct costs are small but non-trivial, ranging from -€0.38 to €5.31 per MWh.

However, other studies on the impacts of the EU ETS on the European power sector overall have shown that the power sector has actually gained substantial windfall profits from the EU ETS. As shown in the tables above, electricity installations receive most of the EU ETS allowances that they need for free. However, they then still pass on the value of these free allowances to electricity consumers by raising the price of electricity. Pass-through rates in the power sector have been estimated to go up to 100% (see e.g. Egenhofer et al., 2011; Sijm et al., 2006).

While there is limited data available to verify this dynamic in the case of Poland, it is nevertheless safe to assume that the EU ETS has most likely also created windfall profits for the Polish electricity sector. These windfall profits are likely to be far greater than the direct costs they incurred. In other words, the flanking measure put in place to mitigate the negative impacts (i.e. free allocation), has overachieved its aim, certainly in the 2008-12 period.

Turning to the future, an important observation is that in phase 3, installations have faced a higher direct cost than in phase 2. As transitional free allocation is set to progressively decrease towards 2020, these direct costs will increase even further, while windfall profits are likely to decrease. Being part of the policy design of EU ETS, the increase of direct costs due to EU ETS is an intended impact of this climate change policy.

B) Renewable energy support (RES) policies

As discussed in chapter 2, under the EU Renewable Energy Directive, Poland needs to increase its share of renewables to 15% by 2020 of gross final energy consumption. The RES Directive has been partly transposed in Poland's National Renewable Energy Action Plan (2010), and more recently in the 2015 Renewable Energy Act. The following policies and subsidies are in place to encourage investment and production of renewable energy (KPMG, 2013):

- Tax exemptions;
- In some cases solar photovoltaic modules cannot be subject to real estate tax as other constructions;
- Agriculture taxpayers may claim a refund of investment costs if the investment relates to renewable energy (up to 25%);
- Subsidies and grants from the EU or domestic institutions (for example, the National Fund of Environmental Protection and Water Management); and
- Support schemes (including green certificates) for solar, wind, geothermal, hydro, biomaterial and offshore technologies.

In this section, the focus is on the system of green certificates. Under this system, producers of renewable electricity are given a certificate for each MWh of green electricity they produce (including from wind, co-fired biomass or other types of renewables). As shown in Table 6, these tradeable green certificates had in 2008-14 a market value between €39.70 and €67.53.

Table 6. Yearly average price of green certificates, 2008-14 (€/MWh)[4]

	2008	2009	2010	2011	2012	2013	2014
PLN	240.79	267.1	274.39	281.3933	251.2092	165.4025	184.2825
Euro	**57.79**	**64.10**	**65.85**	**67.53**	**60.29**	**39.70**	**44.23**

Authors' elaboration on data from: KOBiZE (2015), POLPX Monthly Report 2010 – 2014.

Overall, electricity distributors have a legal obligation to buy an amount of green certificates corresponding to a yearly set quota. If this obligation is not fulfilled, the electricity distributor has to pay a substitution fee which is a price established yearly by the Energy Regulatory Office. As shown in Figure 7, this price has steadily increased from 2008 (€59.63) to 2014 (€72.01), while certificate prices have decreased since 2011.

This price differential is due to issues such as increased production of electricity by renewable sources (most notably from co-fired biomass in thermal power plants, but also some wind and solar power) which has led to an oversupply of green certificates in the market, creating a downward pressure on certificate prices (Polish Wind Association, 2015).

[4] Weighted average index OZEX_A. Prices are converted to euros with an exchange rate of 1 PLN = 0.24 €.

Figure 7. Green certificate and substitution fee prices, 2008-14 (€/MWh)

Authors' elaboration on data from: KOBiZE (2015) and POLPX Monthly Report 2010 – 2014.

Due to a lack of available data, a precise calculation of the cost impacts of the green certificate scheme falls outside the scope of this study. However, rough estimates can be deduced, simply by multiplying the price of the certificates with the renewable electricity production figures for a given year. For the year 2012, for example, the price of a green certificate was €60.29/MWh (and a somewhat higher substitution fee of €68.82/MWh). With a total production of 4,747,000 MWh from renewable sources in Poland in 2012, the green certificate scheme has potentially resulted in benefits of up to €286 million in that year.

The majority of these benefits go to biomass which is the single largest source of renewable electricity in Poland. This means that the system actually supports coal and lignite-fired thermal power plants, because these are the plants that use biomass co-firing to generate electricity (especially a number of older power plants use this technique). In that sense, the system does not really support a transformational shift away from thermal power.

At the same time, the policy does promote and support the use of renewable energy sources, which in addition to biomass also includes a small but growing wind power sector. This intended impact is likely to be at the expense of coal and lignite as a fuel.

Further, the costs of the system are borne by distributors, which pass through these costs in the price of electricity to consumers (households, industry or other users).

It should be noted that renewables continue to represent a modest share of electricity generation in Poland. However, since Poland is aiming the produce 20% of its electricity with renewable energy by 2020, the impact of RES policies might grow in the near future, certainly when taking into account the forthcoming changes in Poland's RE support systems. This includes the gradual introduction of a new, auctioning-based system as established in the 2015 Renewable Energy Act, which also includes a provision to stimulate solar PV micro-installations (see also chapters 2 and 4).

Summary: Cost impacts from the EU ETS and RES policies on the Polish iron and steel sector

1/ EU ETS

- Data indicate small but non-trivial direct costs to the electricity sector in the period 2008-14.
- However, due to high levels of free allocation and a very high pass-through rate, the EU ETS has likely resulted in substantial windfall profits for the sector.
- Since transitional free allocation is set to progressively decrease towards 2020, the direct costs will increase, while windfall profits are likely to decrease.

2/ RES policies

- RES policies, and the green certificates system in particular, are likely to result in a positive impact on the producers of renewable electricity in Poland.
- There are costs for the electricity distributors, which are passed on to the consumers of electricity.
- RES policies, and especially the green certificates system, promote and support the use of renewable electricity sources. This is likely to be at the expense of coal and lignite as a fuel.

Impacts on international trade

International trade, exports and imports, is another important category of impacts. If we look at the recent trends in cross-border trade in electricity and coal in Poland, both seem to follow roughly similar trends in the period 2000-13, certainly with regard to imports: both coal and electricity imports were low in the early 2000s and gradually increased later on. Exports, especially of coal and lignite, were very high at the beginning of the decade and decreased somewhat in later years (26,945,000 tonnes of coal and lignite exports as of 2000; down to 18,035,000 tonnes as of 2013).

The current and expected costs associated with the EU ETS and RES policies may have a negative intended impact on the export of coal and lignite and electricity, but it is difficult to establish a precise cause-and-effect relationship.

In terms of climate change policies, changes in free allocation rules for electricity sector in phase three of the EU ETS indicate that the sector might experience a direct cost from the EU ETS in the future. RES policies, in addition, are already having intended cost impacts on the sector.

Figure 8. Electricity imports export and exports, 2000-13 (MWh)

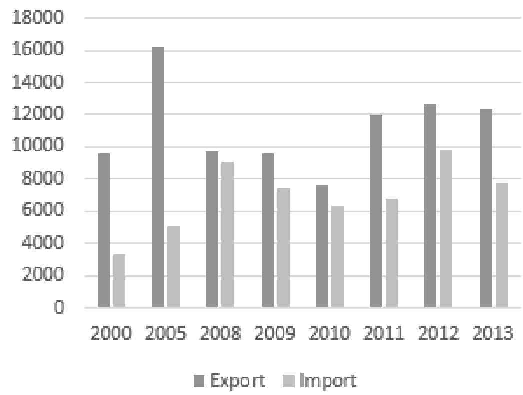
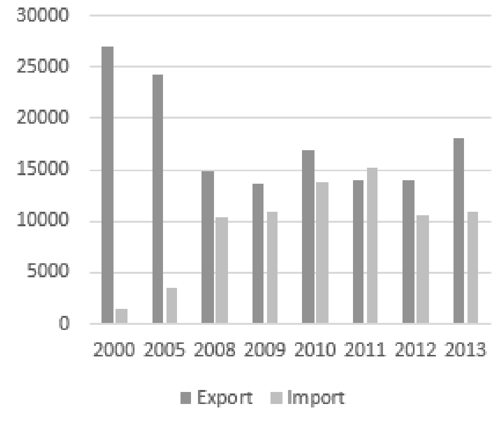


Figure 9. Coal and lignite imports and 2000-13 (thousands of tonnes)



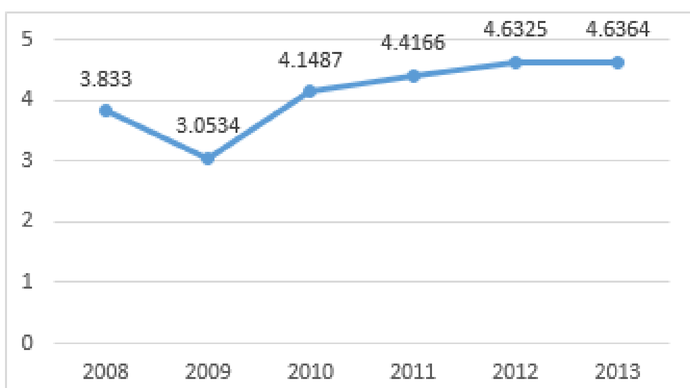
Data sources: Agencja Rynku Energii (Energy Market Agency, Poland) and Eurostat (2015).

Cross-border electricity trade volumes are fairly small, due to limited capacity at the interconnections with neighbouring countries. Additional lines or network reinforcements to expand interconnection capacity are being constructed or planned (IEA, 2011, p. 73).

Impacts on investments

Investments in the electricity sector are slowly increasing, as measured over the 2008-13 period (see Figure 10), from €3.8 billion to €4.6 billion annually. This figure gives an indication as to what is spent at present to refurbish and invest in power plants in Poland. In view of the combined challenges of energy security, the advanced age of the average coal-fired plant in Poland and the need to tackle climate change and environmental pollution, the International Energy Agency expects "massive investments in the short and medium term" (IEA, 2011, p. 11) in the Polish electricity sector.

Figure 10. Investments in electricity, gas, steam and air conditioning supply in Poland (2008-2013)



Source: KOBiZE (2015).

It is safe to assume that so far the EU ETS has not significantly incentivised investment into refurbishment and modernisation of power plants since the sector has not experienced any major cost impacts from the system. The green certificate system and other Polish RES policies, as is intended, in contrast, are much more likely to have incentivised investments, particularly in the field of renewable technologies (including biomass and wind power).

Impacts on production and capacity

In terms of impacts on production and capacity, we see a modest increase in installed capacity of renewables (including biomass), from nearly 4MW installed capacity in the year 2000, to 3429 MW in 2013 (see Table 8). Production figures have increased from 5 GWh to 6004 GWh of green electricity during this same period (2000-13). This remains tiny compared to 30,027 MW of installed thermal power capacity, but the intended positive impact of Poland's green certificate scheme and other RES policies on production is nevertheless very clear. In contrast, we do not observe any significant impact of the EU ETS on production figures at present.

The conclusion is that the green certificate scheme has had a positive impact on renewables energy production. The increase in production has been moderate but significant.

Table 8. Production (GWh) and installed capacity (MW) of electricity in Poland (2000-13)

		2000	2005	2008	2009	2010	2011	2012	2013
Thermal power plants	Production (GWh)	141 063	153 023	151 721	147 669	152 505	157 582	154 926	155 555
	Installed capacity (MW)	28 372	29 815	29 816	29 985	29 908	30 405	30 365	30 027
Hydropower (incl pumped storage)	Production (GWh)	4 116	3 778	2 747	2 974	3 488	2 761	2 465	2 997
	Installed capacity (MW)	2 183	2 321	2 335	2 338	2 342	2 346	2 351	2 355
Renewables (including biomass)	Production (GWh)	5	135	837	1 077	1 664	3 205	4 747	6 004
	Installed capacity (MW)	4	121	526	709	1 108	1 800	2 564	3 429
Total	**Production (GWh)**	**145 184**	**156 936**	**155 305**	**151 720**	**157 657**	**163 548**	**162 138**	**164 556**
	Installed capacity (MW)	**30 559**	**32 257**	**32 677**	**33 032**	**33 358**	**34 551**	**35 280**	**32 382**

Data source: Eurostat (2015).

Impacts on prices

Climate change policies are likely to have generated an impact on electricity prices. Due to the pass-through of costs resulting from the EU ETS as well as RES policies, it is very likely that electricity prices have increased. Of course, electricity price development consists of many different components and the observed trend is not only the result of climate change policies, but is also due to several other factors such as high investment costs related to the modernisation of old installations.

While it is beyond the scope of this study to assess the precise impact attributable to climate policies, it is nevertheless useful to look at the general trend of electricity prices in Poland. Household electricity rates in €/kWh went up considerably between 2000 and 2014, from 8.1 cent in 2000 to 14.1 cent in 2014. Electricity rates for industry, meanwhile, have also gone up, and in fact nearly doubled (although starting from a lower base). In 2000, industrial electricity were at 5.4 cent, and went up to 10.2 cent in 2014 (see Figures 11 and 12).

Figure 11. Household electricity rates, 2000-14 (€/kWh)

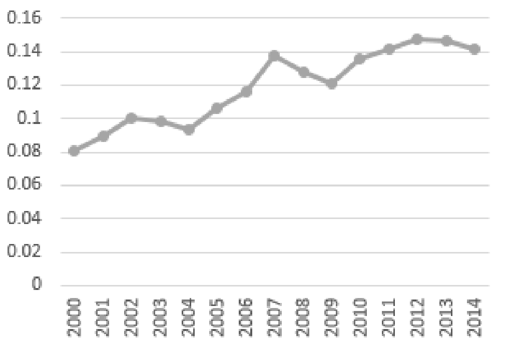
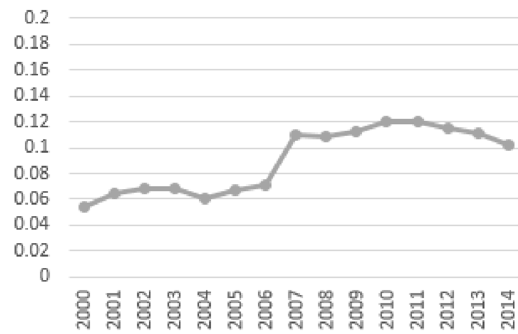


Figure 12. Industry electricity rates 2000-14 (€/kWh)



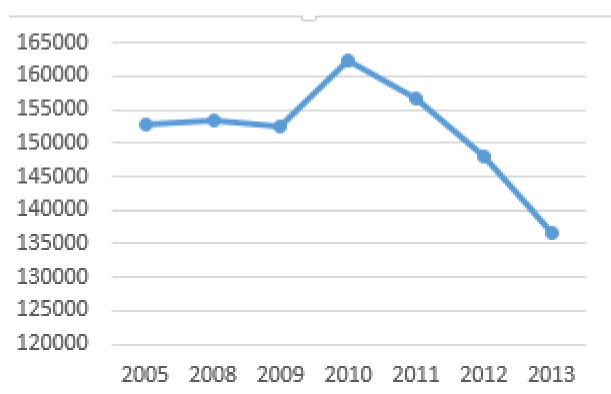
Data source: Eurostat (2015).

3.1.3 Social impacts

<u>Impacts on employment</u>

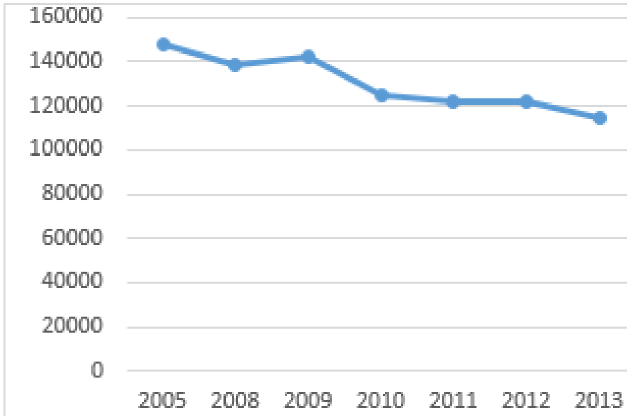
In addition to economic impacts, another important category of impacts are social impacts, most importantly impacts on employment. Figures in both the electricity sector and coal mines show a slightly negative trend in recent years.

Figure 13. Employment in Polish electricity, gas, steam and air conditioning supply, 2005-13



Data sources: Eurostat (2015) and Statistical Yearbook of Industry – Poland, Central Statistical Office (2014).

Figure 14. Employment in Polish coal and lignite mines, 2005-13)



Data sources: Eurostat (2015) and Statistical Yearbook of Industry – Poland, Central Statistical Office (2014).

It is unlikely that the EU ETS, which most likely resulted in windfall profits for coal and lignite-fired plants, is linked to decreasing employment figures. RES policies, however, could have a positive impact on employment in electricity generation with renewable energy (e.g. wind power), while potentially negatively impacting employment in coal and lignite mines.

It should also be noted here that a massive decrease in the number of employees in coal and lignite mines took place in the 1990s, with over 450,000 miners in 1990 and less than 200,000 by the year 2000 (IEA, 2011, p. 81). This took place as a result of the initial socio-economic transition in the 1990s and is not related to the EU ETS or recent RES policies.

Impacts on affordability of energy for households

In addition, potential increases in electricity prices have a social dimension. The price rises which are a likely consequence of the pass-through of costs of climate change policies into electricity prices, might result in households spending more money on their energy bills.

In Poland, the share of energy expenditure within total household expenditure has grown between 2000 and 2010 suggesting that energy affordability has for long been a challenge in Poland despite to economic growth the country has enjoyed in the 2000s (S Bouzarovski, 2011). Reasons beyond climate change policies, such as poor insulation in housing and the previously record-low energy prices dating from the time before transition to market economy, have also impacted the rise of energy consumption and electricity prices (S. Bouzarovski et al., 2013)

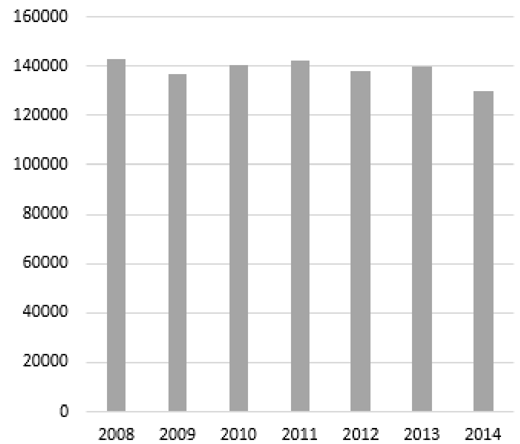
Electricity producers passing through the costs of climate change policies into electricity prices might partly decrease affordability of energy in Poland for the vulnerable groups of society.

3.1.4 Environmental impacts

GHG emissions

We are aware that many international, EU-level and national policies (e.g. the EU's Industrial Emissions Directive, IED) are impacting the environmental performance of the electricity sector, but in order to limit the scope of this study, we concentrate the analysis on the effects of the EU ETS and RES policies on GHG emissions.

Figure 15. Verified CO_2 emissions in electricity generation, 2008-14 (thousands of tonnes)



Data sources: Based on EUTL (2015) and KOBiZE (2015).

As can be seen in Figure 15, GHG emissions from electricity sector have moderately decreased between 2008 and 2014. There are of course multiple factors that affect the overall decreasing trend in GHG emissions, one of which is undoubtedly the 2008-09 economic and financial crisis. A previous study for example has shown that 3.35% rise in emission-intensity improvements could be attributed to EU ETS in 2007-08 (Egenhofer et al., 2011). Also other studies at the European level have demonstrated that at least part of the reductions are attributable to climate and energy policies, and notably the EU ETS (e.g. Laing et al., 2013).

It can be inferred that the EU ETS and RES policies combined, have likely contributed to the observed moderate decrease of Poland's GHG emissions in the power sector.

Summary: Impacts of climate policies (EU ETS and RES policies) on the Polish electricity sector

Economic impacts

- Costs: The EU ETS and RES policies combined result in small but non-trivial costs for power installations and distributors. Most (even 100%) of these costs are passed through to electricity consumers.
- Trade: The current and expected costs associated with the EU ETS and RES policies may have a negative impact on the export of coal and lignite and electricity, but it is difficult to establish a precise cause-and-effect relationship.
- Investments: The EU ETS is not likely to have significantly encouraged investment in the refurbishment of power plants since the sector has been able to pass through the cost impacts from the system. The green certificate system and other Polish RES policies, in contrast, are likely to have encouraged investments in the field of renewable technologies.
- Production & capacity: Poland's green certificate scheme and other RES policies have clearly positively impacted production and capacity figures of renewable electricity (biomass, wind). In contrast, we do not observe any significant impact of the EU ETS at present.
- Prices: The EU ETS and RES policies have very likely generated an increase in industrial electricity prices, due to a high cost pass-through rate.

Social impacts

- Employment: RES policies have likely had a positive impact on employment in electricity generation based on renewable sources, while potentially negatively impacting employment in coal and lignite mines. No impacts from the EU ETS can be inferred. Impacts on affordability of energy for households: The EU ETS and RES policies have very likely generated an increase in household electricity prices, due to a high cost pass-through rate. This can in turn result in higher share of household income spend on electricity bills, having an impact on affordability of energy.

Environmental impacts

- GHG emissions: The EU ETS and RES policies combined have likely contributed to the observed moderate decrease of Polish GHG emissions in the electricity sector.

All in all, we observe fairly modest impacts from climate change policies. Increase in electricity prices for industry and households (economic and social impact) has been the most significant

3.2 Impacts in the iron & steel sector

3.2.1 Sector description

The iron & steel sector has gone through a transformation with Poland moving from a centrally planned economy to market economy, to an even larger extent than the electricity sector. This process resulted in the privatisation and modernisation of the sector demonstrated by the change in the role of the Polish state. In 1990, the sector was dominated by state-owned companies, whereas today the biggest players are multinationals. ArcelorMittal, the world's largest steel producer, has a market share of more than 65% (Gajdzik, 2013) and 70% of production capacity of steel in Poland (ArcelorMittal, 2015).

Concentrated in southern Poland, the sector consists of 45 installations, the largest of them being ArcelorMittal's facilities in Katowice and Kraków. In 2011, the industry's share of total gross added value to the Polish economy stood at 2.4%. In 2008, Poland produced around 0.75% of total world production (1327 million tonnes) of crude steel (Pardo et al., 2012).

The restructuring of the Polish economy resulted in a shift away from the very energy-intensive open hearth furnace (OHF) production process in the early 2000s. In the 1990s, 30% of Polish steel production still used the OHF method (Gajdzik, 2013). This resulted in the sector becoming considerably more energy efficient.

At present, there are two main production models for steel, in Poland and elsewhere: 1) the integrated route (Basic Oxygen Furnace, BOF), which is based on removing impurities from raw iron and 2) the recycled route that uses recycled scrap iron (Electric Arc Furnace, EAF). Steel-making via the integrated route requires iron-making. It is therefore appropriate to analyse steel and iron production as one sector.

Both the integrated route and the recycling route use coal and coke as their main fuel which result in high levels of GHG emissions. The sector also uses electricity from the grid, around 84% of which in Poland is based on coal. In this case study, we look not only at installations producing iron & steel (pig iron, sinter plants, steel production and rolling mills) but also fuel combustion and industrial CHP used by the sector. This results in total of 45 installations.

Central to this study is the fact that the recycled route uses around 80% less energy than the integrated route (European Commission, 2013). The European Commission has estimated that during the period 2005-08, the emissions intensity of the integrated route was on average 2.3 tCO_2/t of rolled products and 0.21 tCO_2/t for the recycling route. This means that the integrated route is a considerably more emissions-intensive than the recycled route (European Commission, 2013).

In 2013, a majority of steel in Poland, 59%, was produced with the integrated route while 41% relied on the recycling route (Polish Steel Association, 2015).

Carbon leakage is frequently seen as the major negative environmental impact of climate change policies.

3.2.2 Economic impacts

<u>*Cost impacts of climate policies*</u>

- A) EU Emissions Trading System – Direct costs

As described in chapter 3.1, the EU ETS has seen some significant changes in its 3rd Phase. For the steel & iron sector, this has meant that in the phase 3 of EU ETS, the sector continues to receive part of its EUAs for free, but has to get the rest through auctions. The reason for continuous free allocation for this sector stems from the perceived risk of carbon leakage for the iron & steel industry.[5]

The methodology to calculate the direct costs for the iron & steel sector is analogous to the methodology described for the electricity sector above, and is based on the following formula:

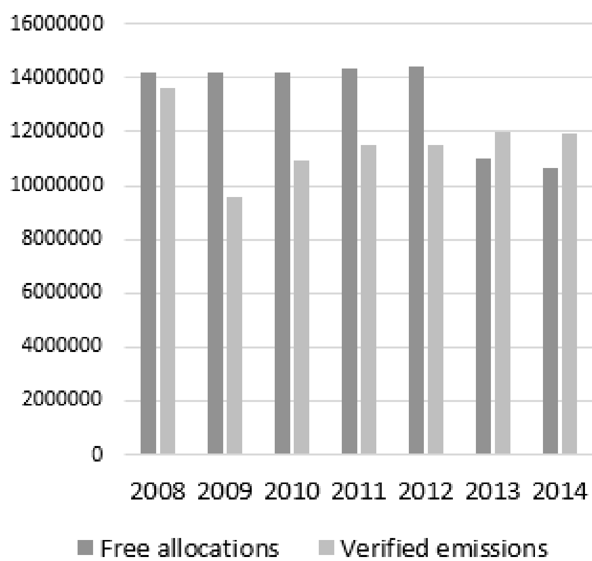
$$Direct\ EU\ ETS\ cost\ (\frac{€}{Tonne\ of\ steel}) = \frac{[Emissions\ (Tonne\ of\ CO_2) - Allocations\ (Tonne\ of\ CO_2)] * CO_2\ price(\frac{€}{Tonne\ of\ CO_2})}{Production\ (Tonne\ of\ steel)}$$

In this formula, production for the iron & steel sector is the estimated crude steel production per tonne (data obtained from the Polish Steel Association; for an explanation of the other terms and data sources used, see the section on the electricity sector above).

- *Direct costs: Results*

Figure 16 shows that in phase 2 (2008-12) of the EU ETS, the iron & steel sector received all its allowances for free and was actually over-allocated. As of phase 3, the sector was short in free allowances, but still received a large proportion for free.

Figure 16. ETS free allocation and emissions in Poland's steel & iron sector, 2014-08



Authors' elaboration on data from: EUTL (2015) and KOBiZE (2015).

A detailed break-down of the emissions, freely allocated allowances and the difference (a negative number represents an overallocation) shows that in the 2008-2012 period, between

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[5] European Commission, Decision determining, pursuant to Directive 2003/87/EC of the European Parliament and of the Council, a list of sectors and subsectors which are deemed to be exposed to a significant risk of carbon leakage.

0.6 and 4.6 million allowances were overallocated to the sector per year. In 2013 and 2014, the sector was respectively short 1.0 and 1.3 million allowances.

Table 9. Emissions and free allocation in iron & steel sector, 2008-14 (millions)

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Emissions	13.6	9.6	10.9	11.5	11.5	12.0	11.9
Allocations	14.2	14.1	14.2	14.4	14.4	11.0	10.6
Difference	**-0.6**	**-4.6**	**-3.3**	**-2.8**	**-2.9**	**1.0**	**1.3**

Authors' elaboration on data from: European Union Transaction Log (2015) and KOBiZE (2015).

The next step is to calculate the direct costs by applying the formula presented above. If we calculate the hypothetical costs without free allocation, i.e. emissions multiplied by the EUA price and divided by production, we observe figures ranging between as high as €32.30 per tonne of steel in 2008 and as low as €6.76 in 2013 (Table 10).

Actual direct costs with free allocations were negative between 2008 and 2012, with windfall profits ranging between €1.4 and €6.01 per tonne of steel. Small but non-trivial direct costs,a s an intended cost impact of EU ETS, are observed in 2013 and 2014.

Table 10. Direct cost of EU ETS for iron & steel sector, 2008-14 (€/tonne of steel) with no pass-

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Without free allocations	€32.30	€17.95	€19.71	€18.00	€10.34	€6.76	€8.23
With free allocations	**-€1.40**	**-€8.66**	**-€6.01**	**-€4.48**	**-€2.64**	**€0.56**	**€0.91**

through of costs

Authors' elaboration on data from: European Union Transaction Log (2015) and KOBiZE (2015).

The observed changes in 2013-14 are due to EU ETS reforms in phase 3, where the iron & steel sector continues to receive part of its EUAs for free, but has to get the rest through auctions. For the whole sector, this has meant an estimated cost of €4,514,467.50 in 2013 and €7,799,428.32 in 2014.[6]

However, the direct cost impact is based on the assumption that in a competitive global market, the industry cannot pass on the cost to the steel consumers. Other studies show that this is not a reliable assumption and results in an over-estimation of the direct costs of the EU ETS (McKinsey, 2006; Vivid Economics, 2014; CE Delft, 2010). An impact assessment from the European Commission (2015) concludes that the iron & steel industry in Europe passes through

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[6] Essentially, the estimated cost for the whole sector is the difference between the amount of EUAs each installation needs to surrender and the number of allowances allocated, multiplied by price of CO_2.

a significant share of its direct EU ETS costs. This rate is estimated to be between 60% and 100% (European Commission, 2015a, pp. 193-202).

There is no precise data available for the case of Poland, but based on these EU figures, it is reasonable to assume that while the Polish steel plants received most of their allowances for free, they still passed on the costs of these free allowances to consumers by raising the prices of steel, generating additional (and substantial) windfall profits.

It is concluded that the sector has not experienced any major direct cost impacts from the EU ETS and is very likely to have actually benefited from significant windfall profits with over-allocations and the potential benefits from pass-through of costs.

There is nevertheless another way through which the sector can incur costs from the EU ETS, namely indirect costs from the use of electricity, as explained in the next section.

B) EU Emissions Trading System – Indirect costs

Electric utilities face increased production costs through their ETS compliance cost. They pass on those costs to their respective customers, including to the iron & steel sector, via higher electricity rates. The iron & steel sector therefore faces an extra cost because of the cost of CO_2 embedded in electricity prices.

The pass-through rate is a number that is contested and may vary significantly between member states. In the calculations presented below, the pass-through rate is assumed to be one (100%), but this is an assumption that may overestimate actual indirect costs.

As electricity intensity of steel production is technology-specific, this study looks firstly at the indirect EU ETS impact in relation to the integrated route and secondly in relation to the recycled route.

This study uses the following formula to estimate the indirect costs of EU ETS for both production processes in the iron & steel sector:

$$
\begin{aligned}
&Indirect\ EU\ ETS\ cost\ \left(\frac{€}{Tonne\ of\ steel}\right) \\
&\qquad = Electricity\ intensity\ \left(\frac{kWh}{Tonne\ of\ steel}\right) \\
&\qquad * Carbon\ intensity\ of\ electricity\ \left(\frac{CO_2}{Tonne\ of\ steel}\right) \\
&\qquad * CO_2\ price\ \left(\frac{€}{Tonne\ of\ CO_2}\right)
\end{aligned}
$$

Where:

- Electricity intensity of steel production: the amount of electricity used to produce one tonne of steel.[7] This amount is plant and technology specific. Plant level data is not available and therefore technology-specific data is used;[8]

[7] Only the electricity intensity of the crude steel production process is taken into account.

- Carbon intensity of electricity generation indicates the amount of tonnes of CO_2 emitted by utilities to generate one kWh; [9] and
- CO_2 price is the average yearly market-price of EUAs (European Energy Exchange, 2015).

Essentially, the indirect cost per tonne of steel, is the electricity intensity of production (KWh of electricity needed to produce one tonne of steel) multiplied by carbon intensity of electricity. This is multiplied by the cost of the allowances purchased.

- *Indirect costs: Results*

Based on a range of electricity intensity figures,[10] a lower and higher range of indirect costs are calculated, both for the BOF and EAF production processes (Tables 12 and 13).

Table 12. Indirect cost per tonne of steel (€/tonne) in the BOF production process

		2008	2009	2010	2011	2012	2013	2014
BOF €/tonne of steel	lower range	€0.20	€0.11	€0.12	€0.12	€0.06	€0.04	€0.05
	higher range	€1.22	€0.70	€0.76	€0.73	€0.40	€0.24	€0.31

Source: Author's own calculations.

Table 13. Indirect cost per tonne of steel (€/tonne) in the EAF production process

		2008	2009	2010	2011	2012	2013	2014
EAF €/tonne of steel	lower range	€8.19	€4.73	€5.15	€4.90	€2.69	€1.60	€2.10
	higher range	€15.16	€8.76	€9.53	€9.06	€4.98	€2.96	€3.90

Source: Author's own calculations.

This shows that the steel and iron sector experienced an indirect costs from the EU ETS in 2008-14. The downward trend in indirect costs reflects the downward trend in EUA prices throughout this period. The tables also show a fundamental difference in the indirect costs installation face between the two technologies. The indirect costs for BOF plants (which are less electricity intensive and rely on utilities for only 20% of their electricity needs) are relatively low, with figures between 0.73 and 0.04 Euros per tonne. EAF installations use electricity as their primary energy input and indirect costs have a far greater impact on their operations. The additional cost per ton of steel is between €1.6 and €15.16.

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[8] Data provided by the European Commission's Member States Best Available Techniques (BAT) Reference report for Iron and Steel Production. The report establishes a large range of energy inputs due to variety of energy management at different sites across Europe. These energy-intensity figures allows- us to carry out calculations which result in the establishment of a higher and a lower range of indirect costs of the EU ETS per tonne of steel. For BOF: Input/output data from 21 existing basic oxygen steelmaking plants in different EU countries are used. For EAF: Input/output data for several electric arc furnaces within the EU.
[9] Communication from the Commission: Guidelines on certain State aid measures in the context of the greenhouse gas emission allowance trading scheme post-2012 (2012/C 158/04).
[10] See footnote 8 above.

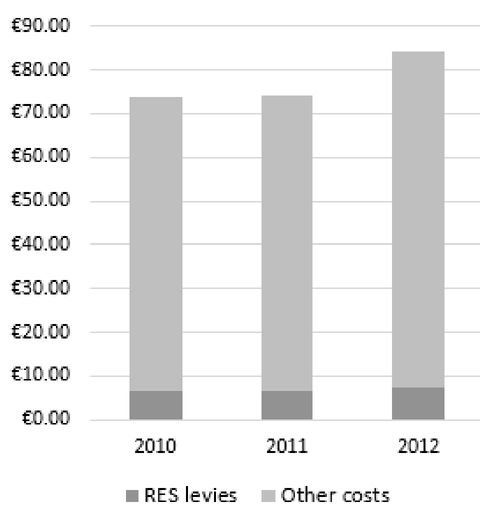
It is concluded that the indirect EU ETS costs depend on the technology that is used. Indirect costs are considerably higher for EAF plants than for BOF plants. On the other hand, these pass-through costs have decreased significantly during the period 2008-14, mainly as a result of decreased prices of allowances.

C) Renewable energy support (RES) policies – indirect costs

As discussed above, Poland has put in place a system of tradable green certificates. This system supports renewable energy production in Poland and obliges electricity distributors to buy either green certificates from renewable electricity producers or pay a substitution fee. In both cases, the cost is passed through to electricity prices, and therefore paid by the electricity consumer. The green certificate scheme therefore leads to an indirect cost for the iron & steel sector.

A previous study has estimated the cost of renewable energy policies in Poland in ceramics, flat glass and chemical industries in 2010-12. This previous study (Egenhofer et al., 2013) is based on an investigation of five plants in Poland and looked at the electricity bills of these plants. It shows that the RES policies amounted to an indirect cost of around 6.9 €/MWh for Polish industry.

Figure 17. Cost of RES levies in price of electricity for industry in Poland, 2010-12



Source: Egenhofer et al. (2013).

The green certificate system is (at the time of writing) the central RES support scheme in Poland. It is therefore reasonable to assume that the observed cost of €6.9/MWh for 'RES levies' in industrial electricity bills is attributable to this system.

It is also important to note that the green certificate scheme is likely to generate a bigger impact on those installations that produce steel with the more electricity-intensive EAF production process compared to the BOF production process.

Summary: Cost impacts from the EU ETS and RES policies on the Polish iron & steel sector

1/ EU ETS

- <u>Direct costs</u>
  The sector has not experienced any major direct cost impacts from the EU ETS and is very likely to have actually benefited from significant windfall profits.
- <u>Indirect costs</u>
  Some indirect costs are observed. These were considerably higher for EAF plants than for BOF plants.

2/ RES policies

- <u>RES policies – indirect costs</u>
  RES policies, and notably the green certificate scheme, generate an indirect cost to the iron and steel sector as a result of higher electricity prices.

3/ Combined impacts

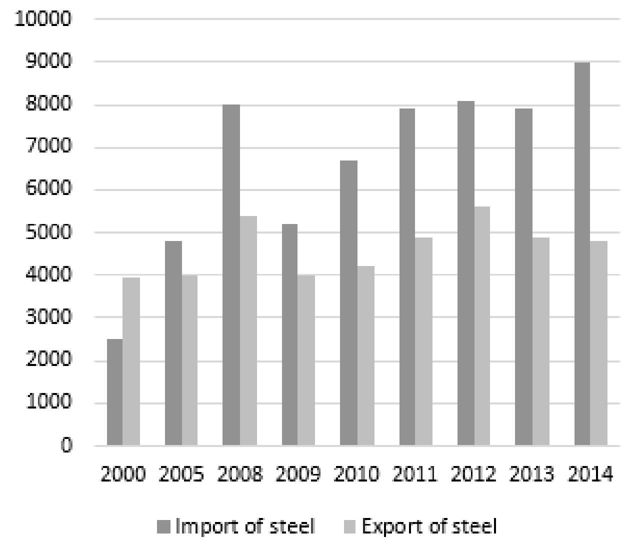
- The net costs are hard to quantify because of the lack of precise data on the pass-through of costs. However, it is a reasonable assumption that the combined cost impacts of the EU ETS and RES policies have been relatively low.

<u>Impacts on international trade</u>

We have not identified any major impacts of climate change policies to exports and imports of steel.

Steel exports have actually slightly increased since the early 2000s, as shown in Figure 18. The Polish steel sector exported 4 million tonnes of steel in 2000 and in 2014 exports of the sector were 4.8 million tonnes. Imports were low in in 2000 (2 million tonnes) and gradually increased later on (in 2014, 9 million tonnes; see Agencja Rynku Energii; Eurostat, 2015).

Figure 18. Trade of steel (thousands of tonnes)



Data sources: Agencja Rynku Energii and Eurostat (2015).

The drop in exports in 2009-11 can likely be explained by the financial crisis in Europe which temporarily decreased demand of steel in sectors that consume steel elsewhere in the EU. (Polish Steel Industry, 2010). In 2012, exports again reached the level of 2008. Similarly, a drop in imports is likely explained by decreasing consumption of steel as demand for steel for example in the construction and automotive industry decreased during the period (Polish Steel Industry, 2012).

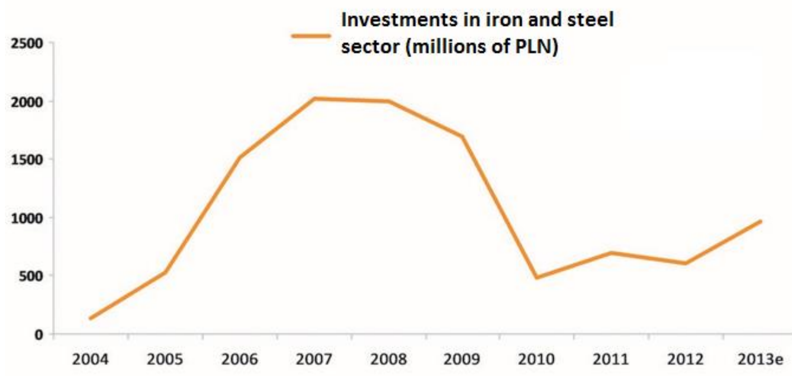
Impacts on investments

A cautious estimation can be made that so far the direct costs of the EU ETS have not to a large extent encouraged investment in the refurbishment and modernisation of the iron & steel sector since the sector has not – as yet – experienced any significant adverse direct cost impacts from the system.

Cost impacts of climate change policies can also lead to carbon leakage resulting in investments being relocated away from Poland to countries with less-constraining GHG emissions policies in place. Since the cost impact of climate change policies has been low, this study does not identify any investments having been relocated away from Poland due to climate change policies. In other words, no carbon leakage on investments has been identified.

The indirect cost from RES policies and the EU ETS, translated into the higher electricity bills in the iron & steel sector, might to some extent encourage investments in technology that uses less electricity.

Figure 19. Investment in iron & steel sector in Poland (millions of PLN)



Source: Polish Steel Association.

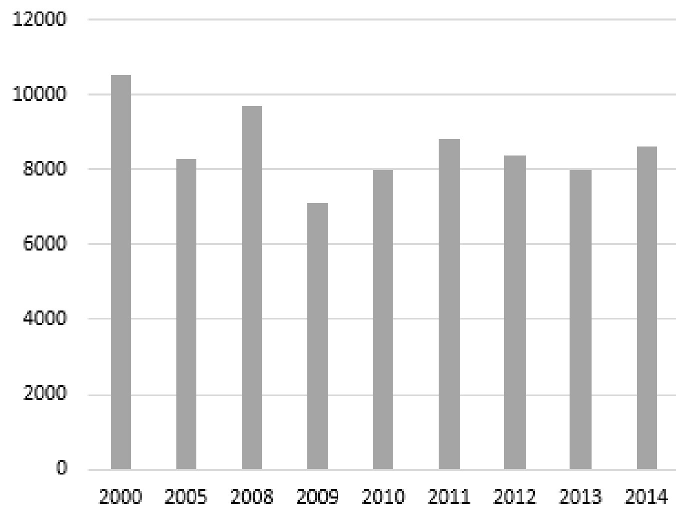
As seen in Figure 19, investments in the Polish steel & iron sector peaked in 2006-09. These investments are related to massive restructuring of the sector and to the completion of large-scale investment projects. For example in 2005-06, Mittal had three large investment projects: a colour-coating line in Świętochłowice, a modernised wire rod mill in Sosnowiec and a continuous casting line in Dąbrowa Górnicza. In 2007, a hot strip mill in the plant in Kraków was activated (AlcelorMittal, 2015). Investments to the sector include also research and development expenditure to new technologies (Polish Steel Association, Annual reports 2005-2006).

Impacts on production

It is difficult to establish a link between climate policies and production figures. There are several factors that can have an impact on crude steel production, for example the privatisation and modernisation process in the Polish industry, changes in global steel production, and developments in domestic and international demand of steel. Climate policies such as the EU ETS or the green certificate system may also play a role, but there is a lack of available data to establish a cause-and-effect relationship.

Production figures in the steel & iron sector range from 11.6 million tonnes in 1997 to 7.1 million tonnes in 2009. Since the decrease in production in 2009, most likely due to the economic crisis, the production level has picked up again. In 2014, the Polish steel industry produced 8.6 million tonnes of crude steel.

Figure 20. Production of crude steel (thousands of tonnes)



Data source: Polish Steel Association (2015).

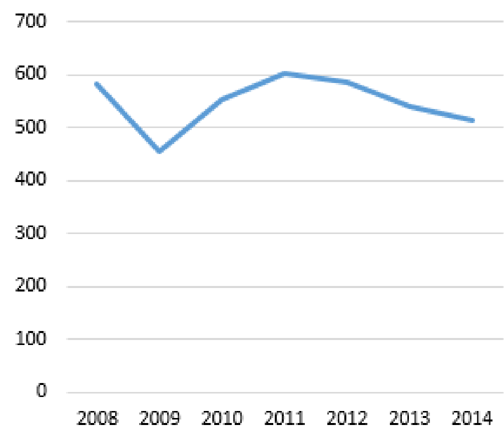
Impact on steel prices

As discussed in above, previous studies show that the iron & steel sector in Europe passes through 60-100% of the costs of the EU ETS to its products. Therefore, it is likely that a part of the price development of Polish steel is to some extent impacted by the EU ETS.

As shown in Figure 21, between 2008 and 2014, the price of a hot rolled sheet of steel[11] has fluctuated between approximately €450 and €600 per sheet. The price saw a stark drop in 2009 dropping from around €600 to €450 in one year. After 2009, the price started to go up, reaching €600 in 2011. Since 2011, the average price of hot rolled sheet has dropped slightly to around €500. The economic crisis is likely to be at least a partial reason for the decrease in price in 2009.

[11] Hot rolled sheet a sheet of metal with dimensions 1500 x 3000 x 4 mm. Average prices are based on data collected weekly from trading companies - members of the Polish Union of Steel Distributors. Prices are converted to euros with an exchange rate of 1 PLN = €0.24.

Figure 21. Average price of hot rolled sheet, 2008-14 (€)



Data source: KOBiZE, 2015 and Steel Price Index.

3.2.3 Social Impacts

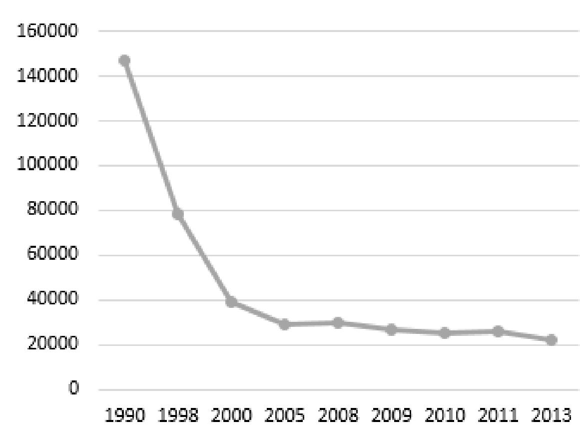
Impacts on employment

In terms of social impacts, we have not identified a direct link between climate change policies and employment figures in the iron & steel sector.

The largest changes in employment have actually taken place prior to the implementation of the climate change policies analysed in this study. After 2009, employment has continued to decrease but the change has been considerably slower compared to previous periods. While the sector employed 26 00 workers in 2009, in 2013 the figure has gone down to 22 000.

Employment figures in steel and iron sector show a strong negative trend in 1990 – 2013. During the socialist period, the steel and iron sector was over-staffed (Trappmann 2013; 38). In 1990, the sector employed more than 140 000 people while in 2013, the figure has gone down to 22 000 workers. (Eurostat, 2015) AlcelorMittal is the biggest individual employer with 12 000 employees in Poland (AlcelorMittal: 2015).

Figure 22. Employment in Polish iron & steel plants, 1990-2013



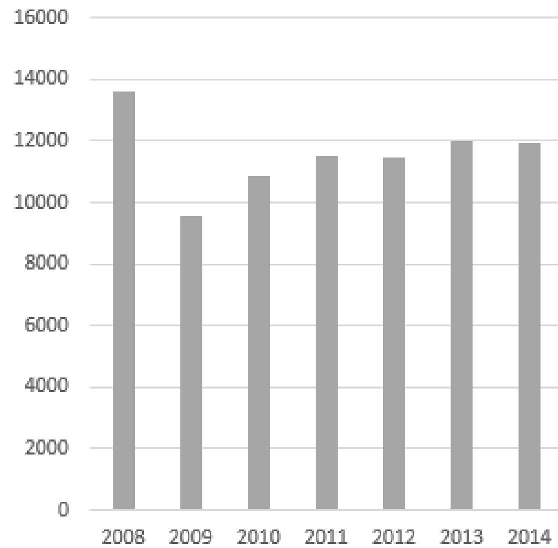
Data source: EUROSTAT (2015).

3.2.4 Environmental impacts

<u>*GHG emissions*</u>

We are aware that many international, EU-level and national policies (e.g. the EU's Industrial Emissions Directive, IED) are impacting the environmental performance of the iron & steel sector, but in order to limit the scope of this study, we concentrate the analysis on the effects of the EU ETS and RES policies on GHG emissions.

Figure 23. Verified CO_2 emissions in steel & iron sector, 2008-14 (thousands of tonnes of CO_2)



Data source: EUTL (2015).

Emissions of the iron & steel sector have decreased significantly from 2008 (13.6 million tonnes). In 2009, the CO_2 emissions decreased to 9.575,137 tonnes. After 2009, CO_2 emissions increased again until 2013 (12 million tonnes) and dropped slightly in 2014 (11.9 million tonnes).

When comparing Figures 20 and 23, it can be observed that the trend in GHG emissions has followed the sector's production trend. Production and GHG emissions both experienced a large drop in 2009 and increased again in 2010. Thus, the decrease in GHG emissions in 2009 is to a large extent related to lower production figures of steel that year, due to the economic and financial crisis.

At the same time, previous studies at the European level have established some links between the EU ETS and emission patterns (Egenhofer et al, 2011; Laing et al, 2013; see also the discussion in the section on the electricity sector above). Even in the case of over-allocation (during 2008-12), the existence of the EU ETS and RES policies, may therefore have exerted a downward pressure on the emissions in the Polish iron & steel sector.

As discussed in chapter 3.1.2, carbon leakage is frequently seen as the major negative environmental impacts of climate change policies. Evidence of carbon leakage would mean that in the case of iron and steel production in Poland, climate change policies would directly or indirectly cause GHG emissions to be displaced from Poland to another jurisdiction where less

GHG constraints are in place. Since this study observes a relatively low cost from climate policies to the sector, no carbon leakage, and negative environmental impact, has been identified.

Summary: Impacts of climate policies (EU ETS and RES policies) on the Polish iron & steel sector

Economic impacts

- Costs: The combined cost impacts (direct and indirect costs) from the EU ETS and RES policies, notably the green certificate system, have been relatively low. In addition, due to strong measures so as to avoid carbon leakage (free allocation, see chapter 4), the sector has actually benefited from windfall profits, certainly during the 2008-12 period.
- Trade: We have not identified any major impacts of climate change policies to exports and imports of steel.
- Investments: The indirect cost from RES policies and the EU ETS, translated into higher electricity bills of iron and steel sector, might to some extent incentivize for investments to technology that uses less electricity. No negative impact due to carbon leakage can be identified.
- Production and capacity: Climate policies such as the EU ETS or the green certificate system may play a role, but there is a lack of available data to establish a cause-and-effect relationship.
- Prices: It is likely that a part of the price development of Polish steel is to some extent impacted by the EU ETS.

Social impacts

- Employment: In terms of social impacts, we have not identified a direct link between climate change policies and employment figures in the iron and steel sector.

Environmental impacts

- GHG emissions: The existence of the EU ETS and RES policies, may have exerted a downward pressure on GHG emissions in the Polish iron and steel sector. No negative impact due to carbon leakage can be identified.

We found a series of negative and positive impacts ranging from direct costs, which are to a significant extent passed through to end-users and GHG emission reductions attributable to climate policies. All in all, it can be observed that impacts from climate change policies have been fairly modest. Possible impact of EU ETS on price development of Polish steel is the most significant observed impact.

4 Mitigation of impacts of climate change policies

The way in which the impacts of climate change policies on the three dimensions of sustainable development are managed will determine whether sustainable development is being achieved. The long-term promise of win-win may be true, but in the short term adjustments will need to be made, and a safety net needs to be put in place.

That safety net includes domestic measures to mitigate impacts put in place by the government, but also tools or measures put in place at the European and international level that are relevant for Poland.

Without claiming to be exhaustive, the next sections first describe the domestic, then the European and finally the international tools that mitigate the negative impacts (costs, employment, trade, investments, production and capacity, prices, and environment) of the selected climate policies (i.e. EU ETS and RES policies) in the Polish electricity and iron & steel sectors.

For the specific case of Poland, it makes sense to also include tools or programmes that were put in place to smoothen the broader transitions which took place in Polish society, but which also affected GHG emissions. Notably this includes the economic transformation in the 1990s, and the accession of Poland to the EU in the 2000s, that is the tools that are designed to tackle specific climate policy impacts (e.g. free allocation in the EU ETS).

4.1 Domestic mitigation tools

4.1.1 Green Investment Scheme

Most of the Green Investment Scheme (GIS) projects are addressing GHG emissions directly (e.g. financial assistance to construct biomass heat and power plants). However, several of them simultaneously lead to lower energy and electricity use, and can therefore be considered as a flanking measure to mitigate the impacts of increased electricity prices. An example of this is the case of the energy-efficient street lighting project as well as the energy management in public buildings programme (see the list below).

As the scheme is essentially based on revenues from foreign financial sources (i.e. other countries such as Spain, Japan, Ireland, etc.), it can also be argued that it mitigates part of the costs associated with GHG emission reduction efforts. This is valid for all eight programmes listed below, including the construction and reconstruction of electricity networks to connect wind power sources to the grid.

Under the GIS, Poland uses the revenues resulting from the sale of its surplus amounts of AAUs (Assigned Amount Units) under the Kyoto Protocol, to invest in climate-friendly projects. As a result of the restructuring in the 1990s, Poland had a large surplus of AAUs. This excess (and the surpluses in other Eastern European countries) causes the buyers' preferences to matter, and as such, Poland decided to engage in AAU trading under its Green Investment Scheme with *inter alia* the World Bank's Spanish Carbon Fund and the Carbon Fund for Europe. The GIS is managed by the National Fund for Environmental Protection and Water Management (see National Fund for Environmental Protection and Water Management, 2015).

Consequently, under the GIS, Poland needs to assure buyers that the proceeds from the sale of AAUs are used to finance agreed projects, and follow-up with credible monitoring and verification process. Poland has so far engaged in the following projects (see National Fund for Environmental Protection and Water Management, 2015):

1. energy management in public service buildings
2. agricultural biogas works
3. biomass heat and power plants
4. construction and reconstruction of electricity networks for connecting renewable wind energy sources
5. energy management in buildings of selected public sector entities
6. energy-efficient street lighting
7. a low-emission urban transport
8. standard of installing hiding places for birds and bats as an element of heat insulation

4.1.2 Thermo-modernisation Fund

This Fund can be considered as a flanking measure that mitigates cost impacts for the residential sector related to increased energy prices and affordability of energy, mainly related to heat. As such, it falls outside the scope of the electricity and iron & steel sectors, but it offers nevertheless a useful example of a measure put in place to mitigate energy-related costs.

The Thermo-modernization Programme and Fund, established in 1998, offers thermo-modernization bonuses as a form of financial assistance from the state to clients who want to carry out energy efficiency projects, mainly in the residential sector. The fund is still operational today and is operated by the Bank Gospodarstwa Krajowego (Poland's only state-owned bank). At present, bonuses are paid out at 25% of the loan used for such an enterprise. An investor who carries out a thermo-modernization investments (e.g. installing insulation) pays off only three quarters of the amount used for the loan. Bonuses can be acquired by housing co-operatives, commercial law partnerships, housing associations, as well as natural persons (Bank Gospodarstwa Krajowego, 2015; see also Rekiel, 2014).

4.1.3 Support for micro-installations under the 2015 Renewable Energy Act

As this measure supports households to consume and produce electricity themselves, it represents an important flanking measure to mitigate the impacts related to rising electricity prices for households that is observed in recent years, including due to climate policies.

As referred to in Chapter 2, the new Renewable Energy Act contains an important provision related to support for prosumers, or users that both consume and produce electricity (e.g. rooftop solar PV panels in households). It is estimated that up to 200 000 such prosumers in Poland could profit from this provision (Ancygier, 2015; Enerdata, 2015). Prosumers will receive PLN 0.75/kWh (€18c/kWh) for micro-installations up to 3 kW, while micro-installations between 3 and 10 kW will receive up to PLN 0.7/kWh (€16.9c/kWh), depending on the renewable technology (Enerdata, 2015).

4.1.4 Coal industry subsidies

The various programmes under which subsidies are granted to the coal industry, have alleviated many of the social (employment) concerns within the coal sector in Poland and demonstrated the importance of social dialogue in smoothening transitions.

In the context of the restructuring of the coal industry, started in the 1990s but still ongoing, the Polish government has been providing significant support to the sector. The economic transition included the restructuring of previously inefficient industries such as coal mining. Such industries usually are unable to restructure without state aid, either because of the large costs involved, or because of resistance from highly organized and powerful labour unions.

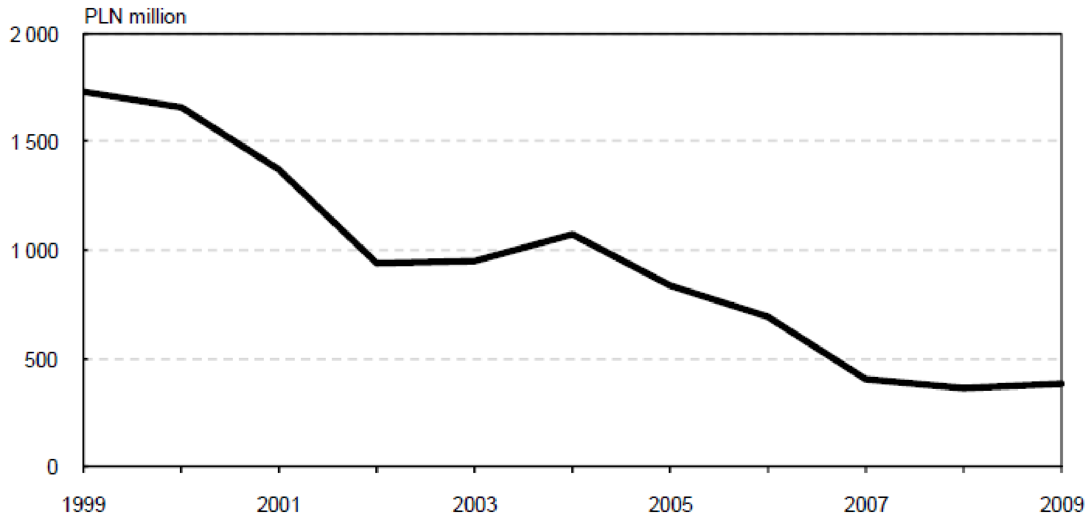
In Poland, both factors played an important role. While over-employment and high production costs resulted in an untenable situation for the coal mines, early government efforts (in 1992-1993) failed to address the issue. Only in 1998, a partial success was achieved by the adoption of a program endorsed by the Solidarity trade union, which included funding to close mines and the provision of significant amounts of social benefits (Suwala, 2010).

After accession to the EU, state aid to the sector was limited in order to be compatible with the common market EU state aid rules.[12] State aid that was still allowed included, in general, historic liabilities including managing safety risks at closed mines, entitlements by retired employees to free coal, other benefits paid to redundant miners and other costs associated with mine closures such as the clean-up of damages of past mining activities (IEA, 2011, p. 92).

The International Energy Agency reports that state aid paid to the sector was as high as approx. PLN 1700 million (€390 million) in 1990 and decreased to about PLN 400 million (€92 million) by 2009-10 (see Figure 24). More recently, total liabilities are estimated to amount to PLN 2.7 billion (€0.62 billion), for the years 2008-15 (IEA, 2011, pp. 92-93).

[12] European Council Regulation 1407/2002 is on state aid to the coal industry. Decision No. K(2005)1796 and Decision No. K(2007)1943 relate specifically to Poland.

Figure 24. State aid paid to the Polish hard-coal sector (1999-2009, in million PLN)



Data source: IEA (2011, p. 93).

4.1.5 Iron & steel restructuring packages

Similar to the coal sector, social packages were put in place in the steel sector to alleviate the negative social impacts of the restructuring process started in the 1990s.

Reduction in employment took place in three phases, "natural" outflows up to 1998, state-led between 1999 and 2003 and, under the influence of EU accession, company-led from 2004 onwards. In the period between 1999 and 2003, two sectoral tripartite agreements, the Steelworkers' Social Package (Hutniczy Pakiet Socjalny, HPS) signed in 1999, and the Steelworkers' Activation Package (Hutniczy Pakiet Aktywizujacy, HPA) signed in 2003. Both packages were targeted at accelerating downsizing (Trappman, 2011, p. 11).

The cost of the packages was shared by the companies, the Polish Ministry of Economy and the EU and included benefits for early retirement, support for training and retraining and alternative job creation. European Commission DG Competition reports that Poland granted a total amount of PLN 2.75 billion (€625 million) in the period 1997-2003 as state aid to the sector (European Commission, 2005: 99).

As in the case of the social programmes in the coal sector, social dialogue with labour unions (and particularly with one union that was very influential, called Solidarity) combined with the necessary funding, went a long way to mitigate the unemployment impacts from the transition.

4.2 EU-level tools

4.2.1 Free allocation in the EU ETS

At the European level, the key tool to mitigate direct carbon costs from the EU ETS – costs that potentially lead to carbon leakage and other impacts as described in the previous chapter – is free allocation of allowances.

In phases 1 and 2 of the EU ETS (2005-07 and 2008-12), most allowances were distributed free of charge. In phase 1, caps were set through European Commission-approved National Allocation Plans, and a maximum of 5% of allowances auctioned. The rest was allocated free of charge on the basis of estimates of historical emissions.

In phase 2, allocations were granted on the basis of the reported emissions in the first phase. The amount of allowances that could be auctioned was also increased, to a maximum of 10% of the total. In addition, international units produced through the Clean Development Mechanism (CDM) and Joint Implementation (JI) were also good for compliance (see section 4.3 below),

The functioning of the ETS saw some significant changes at the start of phase 3 as allocation is now done at the EU level. In general, free allocation decreased and auctioning of allowances increased, with more than 40% of all allowances to be auctioned. In principle, no free allocation is given any longer to the power sector, while the amount of free allocation in phase 3 for energy intensive industry is determined on the basis of historical activity levels and efficiency benchmarks, and an overall cross-sectoral correction factor (CSCF) which ensures that the overall number of allowances given away does not compromise the overall cap of the ETS (see also below).

A. Free allocation for the electricity sector in Poland

For the years analysed in the previous chapter (2008-14), Table 15 shows the total volume of allocated allowances to the 74 Polish electricity installations under the ETS (public power stations and public CHP plants in the EU ETS as identified in the previous chapter). It also shows the yearly average EUA market prices and, based on those figures gives an indicative total value of those allowances per year. In 2008, the total value was 3.06 billion euro, going down to about €1.77-1.06 billion in 2009-12, and further decreasing in 2013 (€343 million) and 2014 (€253 million).

Table 15. Free allocations, prices and total value of free allocations in the Polish power sector, 2008-14

Year	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Free allocation (million allowances)	132.96	133.19	135.40	135.66	140.70	76.15*	42.79*
Yearly average EUA market price (€)	€23.03	€13.31	€14.48	€13.77	€7.56	€4.50	€5.92
Total value of free allocations (billion €)	€3.06	€1.77	€1.96	€1.87	€1.06	€0.343	€0.253

** These figures include transitional free allocation for electricity generation, and free allocation for heat produced in public CHP plants.*

Data source: EUTL, 2015 and European Energy Exchange, 2015.

In principle, free allowances mitigate costs for installations that would otherwise need to buy allowances or make investments that reduce GHG emissions. However, as argued in detail in the previous chapter, the free allowances have actually generated a substantial amount of windfall profits for the power sector, because of a very high pass through rates in the electricity prices (even when allowances are freely allocated).

That is one of the reasons why the sector, as of phase 3, has in principle the obligation to buy all their allocations. However, Poland has obtained the permission to continue the use of temporary free allocations for the power sector. Transitional or temporary free allocation represents a major derogation from the general rule. The EU therefore made it subject to several conditions, as described by the European Commission (European Commission, 2012a):

- It must finish in 2019 at the latest;
- It is limited to no more than 70% of emissions for domestic electricity supply in 2013, declining annually thereafter;
- The value of the free allowances must be channelled into investments in retrofitting and upgrading the country's energy infrastructure, including new power plants and diversification of the energy mix and sources of supply, and into clean technologies. These investments have to be set out in a national plan.
- The Commission must assess the application for consistency with the rules of the ETS Directive.

In the case of Poland, we do indeed see a decrease in free allowances from 132-140 million throughout phase 2, down to 76 and 42 million allowances in 2013 and 2014, the first two years of phase 3. The associated total value of the allowances, in combination with significantly lower average EUA prices, also declined (see Table 15).

In summary, free allocation has (more than) mitigated the direct cost impacts of EU ETS for the sector. However, it did not prevent price increases for end-users, including households, services and industry.

B. Free allocation for the Polish iron & steel sector

In phase 2 (2008-12), the Polish iron & steel sector was over-allocated, receiving more free allowances than they actually needed to comply with the cap. As of phase 3 (2013-20), energy intensive industries receive part of their allocation for free, but have to get the rest through auctions.

Allocation to the iron and steel industries are determined by using product benchmarks,[13] according to Decision 2011/27/EU.[14] The average carbon-intensity of the 10% best performers

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[13] Benchmarks for the iron and steel industry are reported in Methodology for the free allocation of emission allowances in the EU ETS post 2012. Sector report for the iron and steel industry. Study commissioned by the European Commission to Ecofys (project leader); Fraunhofer Institute for Systems and Innovation Research; and Öko-Institut. Available at:
http://ec.europa.eu/clima/policies/ets/cap/allocation/docs/bm_study-iron_and_steel_en.pdf

[14] Commission Decision determining transitional Union-wide rules for harmonised free allocation of emission allowances pursuant to Article 10a of Directive 2003/87/EC of the European Parliament and of the Council (2011/278/EU)

represents the benchmark for allocating free emissions. Steel making (NACE v.2 sector 24.10) and the casting of iron tubes (NACE v.2 sector 24.21) are included in the carbon leakage list (Renda et al., 2013).Those installations that meet the benchmark receive all their allowances for free. Those installations that do not meet the benchmark, receive a lower amount of free allocation, and are thereby incentivized to catch up to their best-performing peers.

BOF steel makers are also entitled to receive free allowances for the electricity generated through recycling of waste gases. Although free allocation of allowances for electricity production is prohibited, an exception is provided for waste gas electricity (Art 10A.1 of the ETS Directive).

Table 16. Free allocations, prices and total value of free allocations in the iron & steel sector, 2008-14

Year	2008	2009	2010	2011	2012	2013	2014
Free allocation (million allowances)	14.2	14.2	14.2	14.3	14.4	11.0	10.6
Yearly average EUA market price (€)	€23.03	€13.31	€14.48	€13.77	€7.56	€4.50	€5.92
Total value of free allocations (million €)	€326.9	€188.9	€205.8	€197.8	€109.0	€49.6	€63.0

Data source: EUTL, 2015 and European Energy Exchange, 2015.

As shown in Table 16, the total value of freely allocated allowances to the iron & steel sector, calculated on the basis of yearly average EUA market prices, was as high as €326.9 million in 2008, fluctuated between €205.8 and €109.0 million between 2009 and 2012, and dropped to €49.6 million (2013) and €63 million (2014) in the first years of phase 3. The latter drop in value is due to both stricter limits on free allowances because of the benchmark approach in phase 3 and lower average EUA prices.

Again, in principle, free allowances mitigate costs for installations that would otherwise need to buy allowances or make investments that reduce GHG emissions. Analogous to the electricity sector however, the free allowances have actually generated a substantial amount of windfall profits for the iron & steel sector, because of a 60-100% pass-through rate in the prices of steel (even when allowances are freely allocated). In addition, the Polish iron & steel sector was over-allocated throughout 2008-12, and was only short starting from 2013 (see above).

It can be concluded that free allocation has (more than) mitigated the direct cost impacts of EU ETS for the sector. However, free allocation has not necessarily prevented other impacts such as steel price increases for end-users.

4.2.2 State aid to mitigate indirect costs from the EU ETS

In another attempt to stem risks related to carbon leakage, a new measure has been introduced in phase 3 (art. 10A.6 of the Directive), which allows EU member states to grant state aid (financial compensation) to compensate indirect carbon costs caused by higher prices for electricity.

Although state aid is allowed under EU ETS rules, and there is evidence that suggests indirect costs for the steel industry in Poland (see previous chapter), the country has not notified the Commission of any such aid to its industry (see EU Competition and Regulatory, 2014).

4.2.3 Operational Programme Infrastructure and Environment for the years 2007-13 and 2014-20

Finally, within the framework of the 'Convergence' objective, the EU co-funds the Operational Programme Infrastructure and Environment for the years 2007-13 / and its follow-up programme for the years 2014-20. These are very large infrastructure funding programmes, with funding of over €30 billion each, largely met by funds from the Cohesion Fund and the European Regional Development Fund (ERDF).

Specifically the last programme, for the years 2014-20 has a very strong focus on financially assisting Poland to transition towards a low GHG emission economy, with explicit references to Polish 2020 RE and GHG targets, in addition to a strong focus on transport and railway development. In that sense, these programmes can be considered as mitigating some of the Polish government’s costs in developing the necessary but costly low emission infrastructure.

4.3 International tools

4.3.1 World Bank support

The World Bank has been assisting Poland since the early 1990s with various transition-related programmes, and has contributed funding (loans) for e.g. the social packages in the coal sector (World Bank, 2001). It has also played a pivotal role in the development of the Polish Green Investment Scheme, by providing capacity and liaising with funders, resulting in e.g. the sale of AAUs through the World Bank’s Spanish Carbon Fund (World Bank, 2012).

4.3.2 DM and Joint Implementation

Other international tools that assisted to offset some of the costs due to climate policies, particularly in the context of the EU ETS, is the access granted to international credits from the CDM (Certified Emission Reductions or CERs), and the development of Joint Implementation projects (producing Emission Reduction Credits, ERUs).

With regard to Joint Implementation, under which Poland can act as a host country, 37 projects were implemented between 2008 and 2012, resulting in total actual GHG emission reductions of 25 Mt CO2-eq during that period. The resulting ERUs were mostly transferred to international firms, carbon brokers, German and Japanese industrial concerns and some banks. In addition, one of the purchasers was a Danish governmental agency (KOBiZE, 2014). These JI projects are therefore another source of funding for GHG abatement projects for Poland.

Industrial players in the EU ETS were also allowed access to international credits, with CERs from the CDM accounting for the lion's share. For the entire period between 2008 and 2020, approximately 1600-1700 credits (CERs and ERUs) are allowed to be used for compliance. In total EU operators used 1059 million credits during 2008-12 and swapped 133 million credits in 2013, leaving another 400-500 million credits to be used for compliance between 2014 and 2020 (World Bank, 2014: 109).

As these credits are generally much cheaper than EUAs (CER prices dropped to €0.3-0.4 in 2013 and remained low in subsequent years), this can also be considered as a cost mitigation measure.

4.4 Potential international and EU-level mitigation tools

There are several other European and international venues that Poland can consider to use as flanking measures to mitigate negative impacts from climate polices. These include:

- NER 300 (innovation fund) for renewable energy and CCS projects
- The proposed EU ETS Modernization Fund (post-2020)
- EU-level R&D funding
- International carbon markets

Under the NER 300, only 1 Polish project has been implemented so far, in the first call for projects: the BIOg CEG Plant Goswinowice. This project is a bio-ethanol production plant with total project funding of €30 million (adjusted funding rate, €/MWh: 29.4; see European Commission, 2015f). It cannot really be considered as mitigating any negative impacts described in chapter 3, but other projects under this programme may still be developed.

In the proposal for the reform of the EU ETS post-2020, a Modernization Fund is also on the table, which could again assist Poland and other poorer EU member states in their transition towards a more modern and energy efficient, and thus less GHG-intense economy.

Another important venue, specifically for the electricity and iron & steel sector, pertains to the EU channels available to support R&D and innovation such as Horizon 2020 and other mechanisms which are increasingly focusing on low-GHG or more energy efficient technologies.

A final option depends on the developments of the international negotiation process, and includes the future use of international carbon markets, either project-based or otherwise, in the global climate regime.

5 Conclusion

This case study looked at the low-GHG emissions transition that has arguably been initiated in Poland and studied whether the transition is being undertaken in a sustainable way, by examining the impacts of climate policies on the three dimensions of sustainable development (social, environmental and economic) and identifying the measures put in place to mitigate them.

There are at present a host of international, EU and Polish policies, laws and programmes intended to guide this transition. Two important ones that were analysed in-depth in this case study are the EU Emissions Trading System (EU ETS) and Renewable Energy support (RES) policies. With regard to RES policies, the most important operational policy during the past 10 years is the Polish system of green certificates, which also creates a market and therefore a cost for participating industries.

In the chapter on impacts, we found a series of negative and positive impacts for the two sectors that we focused on, namely electricity and iron & steel. These impacts range from direct costs, which are to a significant extent passed through to end-users, rising electricity prices, especially for households, a small but notable change in electricity production figures, namely away from coal and towards biomass and (some) wind power, and GHG emissions reductions attributable to the climate policies in both sectors, just to name some of the most significant ones.

But there is also a whole range of mitigation policies put in place in Poland, both at the domestic and European but also at the international level. In addition to very specific mitigation measures addressing concrete climate policy-related impacts such as free allocation in the EU ETS, we also identified a number of social programmes that were used to tackle negative (social) impacts from the transition in the 1990s. The programmes are interesting to look at in the context of this study, not only because they arguably mitigate (a fraction of the) *current* impact of climate policies, but also because they provide lessons as to how Poland has mitigated the impacts of other, but related, transitions.

One of the lessons learned from this case study is that financial resources, combined with social dialogue, can alleviate some of society’s resistance to transitions, including the transition towards a low-GHG economy. Another important message is that at present, the negative impacts of climate policies in Poland are relatively mild, while in the future, it is likely that sufficient mitigation measures can be put in place to address possible negative impacts.

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Annex I: International, EU level and national level climate related policies

International climate change related policies

4. The *Montreal Protocol on Substances that Deplete the Ozone Layer* which was adopted in 1987, was designed to reduce the production and consumption of ozone depleting substances. These substances are often used in refrigeration, air-conditioning, foam manufacturing, aerosol production, and fire extinguishing. The Montreal Protocol aims to reduce these substances in the atmosphere so as to protect the ozone layer. Poland has ratified the Montreal Protocol in 1990.

5. The *1979 Geneva Convention on Long-range Transboundary Air Pollution (LRTAP)* was the first international agreement to tackle air pollution on a transnational (regional) basis. It has since been extended by 8 different protocols. The history of the Convention dates back to the 1960s, when the link between sulphur emissions in continental Europe and the acidification of Scandinavian lakes became clear. The protocols also cover other air pollutants in addition to SO_2 and reducing these pollutants in some cases also contributes to the reduction of greenhouse gases, with the adoption on rules for reducing particulate matter, including black carbon, in a 2012 amendment to the Gothenburg Protocol as a case in point (UNECE 2012).

6. The *International Civil Aviation Organization (ICAO)* agreed to establish a global market-based mechanism (MBM) in an effort to address the rapidly rising GHG emissions of the international aviation sector. By 2016 the mechanism should be developed and it should enter into force by 2020. The agreement also mentions technical and operational measures for mitigating emissions, among which biofuels and the possibility of member states implementing a separate MBM in the period up to the establishment of an international mechanism (Source: ICAO report of the executive committee 38th session of agenda item 17 – section on climate change). Interviews with stakeholders have indicated that the most likely candidate for global implementation is an offsetting mechanism. Costs would be kept low by allowing carbon units from a wide variety of offsetting mechanisms (including the CDM and possibly REDD+). This would be coupled with a previously confirmed aspirational goal of carbon neutral growth of the aviation sector after 2020.

7. In the *International Maritime Organization (IMO), a* global market-based measure (MBM) to mitigate GHG emissions is also under discussion. MBMs under consideration include an offsetting fund financed by a tax on bunker fuels, an energy efficiency crediting and trading scheme and a global ETS for international shipping. Concerns from developing countries are taken on board by discussions on mitigation of adverse effects, for instance through a rebate mechanism compensating developing countries (IMO 2015). The EU has been active both domestically and internationally (in the IMO) to develop market based instruments in the international maritime sector (European Commission, 2013). It is supporting discussions on a global ETS by preparing for its possible implementation: MRV

requirements have been set in emissions from large vessels (over 5000 gross tonnage) visiting EU ports 2018 onwards.

EU level climate change related policies

4. The *Effort Sharing Decision (ESD)* establishes national emission targets for 2020 in non-ETS sectors. These targets are based on 2005 levels. They have been calculated on the basis of member states' relative wealth (measured by GDP per capita). The targets range from a 20% emissions reduction to a 20% increase. By 2020, Poland is allowed to increase its emissions by 14%.

5. The *CCS Directive* promotes the development of CCS in the EU. CCS is considered essential to achieve the EU's long-run GHG emissions reductions target, considering the "theoretical limits to efficiency and the inevitability of some process emissions remaining in certain industrial sectors" (EC 2030 Framework Communication). At the same time, the high costs of CCS serve as a barrier to uptake, including in Poland.

6. The 2012 *Energy Efficiency Directive* contains a collection of binding measures to help the EU reach its 20% energy efficiency target by 2020. EU Member states were required to transpose the Directive into their national laws by June 2014. Member States have set their own indicative national targets, which, dependent on country preferences can be based on primary or final energy consumption, primary or final energy savings, or energy intensity. Poland has set itself an indicative target of reducing primary energy consumption by 13.6 Mtoe, compared to 2020 projections. In conditions of economic growth, this would mean an improvement in the energy efficiency of the economy.

7. The *2010 Energy Performance of Buildings Directive* outlines, first, that energy performance certificates should be included in all advertisements for the sale or rental of buildings in the EU. EU member states must further establish inspection schemes for heating and air conditioning systems in building, while all new buildings must be nearly zero energy building by the end of 2020. New minimum energy performance requirements are to be put in place, and member states have to develop a set of national financial measures to promote energy efficiency in buildings (European Commission, 2015c).

8. The *Fuel Quality Directive* requires a reduction of the greenhouse gas intensity of the fuels used in vehicles by 6 % by 2020, and it also regulates the sustainability of biofuels. It has previously led to drastic reductions in the sulphur content of fuels, enabling the deployment of vehicle technologies to reduce greenhouse gas and air pollutant emissions, and delivering substantial health and environmental benefits. The Fuel Quality Directive applies to all petrol, diesel and biofuels used in road transport, as well as to gasoil used in non-road-mobile machinery.

9. EU legislation on *Car Standards* sets binding emission reduction targets for new cars. This legislation is a key part of Europe's strategy to improve the fuel economy of cars sold on the market. Similar legislation and targets are in place for new vans. The

rules requires that new cars registered in the EU do not emit more than 130 grams of CO_2 per km on average by 2015. By 2021, the fleet average to be achieved by all new cars is 95 grams of CO_2 per km (European Commission, 2015b).

10. The *F-gas Regulation* obliges *inter alia* the heating, cooling and refrigeration industry to regulate and sharply reduce the use of HFCs (which have a global warming potential 11700 times greater than CO_2) in appliances. This requires additional investments, but can also reward early movers on the global market for technological alternatives. A new Regulation (Regulation (EU) No 517/2014), which replaces the 2006 Regulation (EC) No 842/2006 and applies from 1 January 2015, strengthens the existing measures and introduces a number of far-reaching changes. By 2030 it will cut the EU's f-gas emissions by two-thirds compared to 2014 levels.

National level policies

5. *Poland's Climate Policy: The strategies for greenhouse gas emission reductions in Poland until 2020*; was adopted in October 2003. Its strategic goal is to let Poland join in the efforts of the international community to protect the global climate through introducing sustainable development. However, this document stems from Poland's pre-accession period, is outdated and has no practical relevance (Dreblow et al., 2013, p. 2).

6. *Polish Strategic Plan for Adaptation to Climate Change (SPA2020) with the perspective by 2030* was developed by the Ministry of Environment and adopted in 2013. It documents current domestic impacts of climate change and develops future impact scenarios, including for a number of vulnerable sectors and regions in Poland. It also sets up a series of adaptation measures for each affected region and sector and ensures the mainstreaming of adaptation into sectoral policies, primarily those related to agriculture and forestry, biodiversity, ecosystems and water resources, coastal zones and infrastructure. As a result of adopting the Plan by the Council of Ministers all big cities will elaborate their Adaptation Plans that should follow the SPA. The elaboration of the City Plans is financed by the National Fund for Environmental Protection and Water Management.

7. As part of the various international and EU policies listed in Chapter 2.2, Poland needs to meet a series of *national targets on EE and biofuels:*
    - Under the EU Effort Sharing Decision (ESD), Poland needs to limit the growth of its GHG emissions not covered by the EU ETS to 14% above 2005 levels by 2020. Total emissions in 2013 were already about 10% above 2005 levels (EEA 2014: 51; see Figure 13).
    - In addition, Poland faces a non-binding target to reduce energy consumption by 20% of the projected 2020 levels.

8. The 2009 *Energy Policy of Poland until 2030* establishes a vision of Poland's energy future, based on the following 6 'directions':
    - To improve energy efficiency;
    - To enhance security of fuel and energy supplies;

- To diversify the electricity generation structure by introducing nuclear energy;
- To develop the use of renewable energy sources, including biofuels;
- To develop competitive fuel and energy markets;
- To reduce the environmental impact of the power industry.

The document does not explicitly set priorities and specifications of the desired energy mix through 2030, but does include, in an appendix, a projection for the demand for fuels and energy until 2030. It also reiterates Poland's 15% RE by 2020 target and commits Poland to "devise a path" to reach it (p. 18). The policy is currently undergoing review. Changes in the generation structure foreseen at the origin are not happening – nuclear power won't be built before 2030 – if at all. The revised energy policy will look at trends up until 2050 with new projections, but these remain to be decided at the time of writing.

9. The *Act of 15 April 2011 on Energy Efficiency* lays down the national target for energy management in the economy until 2016 at the level of 9% of the average national final energy consumption, averaged from 2001-2005. One of the basic mechanisms of the Act is the introduction of the system of energy efficiency certificates, the so-called "white certificates", which confirm that measures leading to specific energy savings have been taken, including:
   - the modernisation of local heating networks and heat sources;
   - buildings;
   - lighting systems;
   - household appliances; and
   - equipment used in industrial processes.

10. The *Act of 25 August 2006 on Bio-components and Liquid Biofuels* and the *Long-term Program to Promote Biofuels or Other Renewable Fuels for 2008–2014* include measures to enhance and promote the use of biofuels for transport (e.g. excise duty exemptions), that are built upon in Poland's energy policy and national renewable energy plan to achieve its 10% biofuels target by 2020.

11. The *Operational Programme Infrastructure and Environment 2007 – 2013*, is a European Commission approved programme for the years 2007 – 2013, and had a total budget of €37.56 billion, with €22.18 billion from the Cohesion Fund and €5.74 billion from the European Regional Development Fund (ERDF). It aimed to support the development of technical infrastructure, while simultaneously improving environmental protection and health as well as preserving cultural identity and developing territorial cohesion. It covered a wide variety of infrastructure works – many of them relevant to climate change – including in the transport, waste, energy (including renewables), education and health care sectors (European Commission, 2015b). Attention for climate change efforts was stepped up in the follow-up programme, *Operational Programme Infrastructure and Environment 2014 – 2020*, which has a total budget of €32.27 billion. It mainly concentrates its resources on transport infrastructure (including on railway development), the development of a

low-carbon economy, and climate change adaptation, risk prevention & management and environment protection (European Commission, 2015g).

12. The *Transport Development Strategy for 2020 (with the prospect of 2030)* is also directly and indirectly related to climate efforts in Poland. It translates, for instance, the EU target to achieve a 10% share of biofuels in the transport fuel market and has, more generally, as one of its objectives to limit the negative impacts of transport on the environment, based on the following principles:
    - diversity and complementarity of the modal balance of transport connections within the system;
    - domestic and international aspects;
    - organisation of transport solutions that are least polluting;
    - manage demand for transport;
    - implementation of modern transport technologies reducing negative impacts of transport on the environment.

    The strategy on transport development is accompanied by a range of specific policies, regulations and programmes, with those on rail transport being most relevant for climate change, namely the *Master Plan for Rail Transport in Poland until 2030 (2008)* and the *Long-Term Rail Investment Programme until 2013 with an Outlook until 2015 (2011).* As road transportation is the only sector with rapidly growing GHG emissions, the development of a rail network seems to be the best remedy that would redirect the load of commodities from roads to railways thus limiting long range road transport.

    In addition to this list of policies, legislations and infrastructural/development programmes that are relevant for climate change, Poland has also been working on a *National Programme for the Development of a Low-Carbon Economy*. The Ministry of Economy is responsible for the work and a set of assumptions has been were adopted by Poland's Council of Ministers on 16 August 2011. According to these assumptions, the programme should help to generate economic, social and environmental benefits resulting from the reduction of GHG emissions, up to 2050. By 2015, unfortunately, no significant progress has been made (see also Ministry of Economy, 2015b).